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Environment in decentralized development

Economic and institutional issues

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Economic and institutional issues

Prepared by
Vito Cistulli
Agricultural Policy Support Service
Policy Assistance Division

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FOREWORD

As presented in its contribution to the World Summit on Sustainable Development, FAO addresses the environmental challenges and trade-offs created by changes in agriculture, forestry and fisheries in its programmes and activities for Sustainable Agriculture and Rural Development (SARD). The main goal is to eradicate hunger and poverty which are linked in a vicious cycle to unsustainable practices and environmental degradation. Desertification, soil fertility decline, deforestation, depletion of fish stocks and loss of biodiversity all have devastating consequences for the livelihoods of the world's poor.

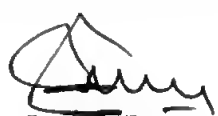
The Declaration of the *World Food Summit: five years later* underlines the contribution of sustainable management of natural resources to food security and poverty eradication. The same recognition can be found in the *New Partnership for African Development* (NEPAD) which highlights the environment as a priority area for policy reform and increased investment. Conservation and development of natural resources are also priority areas of the *Anti-Hunger Programme* which sets out key actions to be taken internationally and by countries themselves to achieve the World Food Summit target of halving the number of chronically undernourished by 2015.

This publication is part of FAO's work for sustainable agricultural and rural development. In particular, it is part of its programmes of capacity building for local level governance and for supporting the application of a new development paradigm fostering the most sustainable use of natural resources at farm, community and ecosystem level. It originates from the capacity building experience of the Policy Assistance Division in many countries, where local government officials addressed the environment primarily in a regulatory role.

The text presents an overview of the concepts and definitions of environment and sustainable development, emphasizing the importance of environment and natural resources for the economies of developing countries. Its aim is to provide basic knowledge and analytical tools related to environment-economy interactions, how these should be taken into account in decision-making at the decentralized, or sub-national, level. It reviews the role of the government and the instruments at its disposal, in addition to regulatory instruments, to create a context in which environmental issues are analysed and addressed.

While the original target group for this publication are government officials working at sub-national level, the text is of interest to all those involved in development work in a decentralized context.

We hope that this publication, with its focus on economics and institutional analysis, will contribute to the holistic and interdisciplinary development planning practices required for sustainable development. Comments and feedback are very welcome.



Santiago Funes
Director
Policy Assistance Division

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ACRONYMS

AC	Average Cost
AVP	Average Value Product
AEC	Agro Ecological Cell
AEZ	Agro Ecological Zones
CVM	Contingent Valuation Method
GDP	Gross Domestic Product
FNPV	Financial Net Present Value
HDI	Human Development Index
HDSI	Human Development Sex-Specific Index
HPI	Human Poverty Index
HPM	Hedonic Pricing Method
ITCM	Individual Travel Cost Model
IUCN	International Union for Conservation of Nature and Natural Resources
NGO	Non-governmental Organization
M&E	Monitoring and Evaluation
OECD	Organization for Economic Co-operation and Development
PRA	Participatory Rural Appraisal
RRA	Rapid Rural Appraisal
TCM	Travel Cost Method
UNACC	United Nations Administrative Committee on Coordination
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
UNDP	United Nations Development Programme
WTP	Willingness To Pay
WWF	World Wide Fund for Nature
ZTCM	Zonal Travel Cost Model

INTRODUCTION

Goals of sustainable development planning

It is well accepted now that planning for sustainable development aims at maintaining or improving the welfare of people as well as the ecosystem which supports the economic activities and life on earth. The achievement of these two broad goals requires that economic, social, and environmental dimensions be considered in an integrated fashion in the design and formulation of development strategies.

The exclusion of one of these potentially conflicting dimensions or their consideration in separate strategies may lead to misleading signals about: i) how people evaluate their preferences and priorities; ii) the knowledge needed to address the complex economic, social, and environmental interactions; iii) the technologies required to avoid or counter the undesirable negative environmental effects of economic development. Moreover the trade-offs among the three objectives may be more difficult to assess.

Need to integrate economic, social and environmental dimensions

In most countries, economic, social, and environmental strategies continue to be designed and implemented separately. This is true for all types of development strategies and plans at any level: international, national, sub-national, sectoral or multi-sectoral, but it is especially true for planning at the local level despite the increasing attention placed in the 1990s on a more integrated approach to sustainable development decision-making.

Role of economic analysis

It is beyond the scope of this document to address in detail all of the three dimensions mentioned above. The major purpose here is rather to point out the role of economic analysis in providing some answers to fundamental questions related to decentralized decision-making for sustainable development, such as: (i) why we should care for the environment; (ii) whether and how decentralization can contribute to sustainable development; (iii) what decision-making framework is best suited to account for environmental, economic, and social issues in decision-making at a decentralized level; (iv) who should make decisions and who should implement them, how decisions should be made and how they should be implemented; and (v) how to monitor the effects of the measures implemented.

This is done by providing the reader with a number of economic principles, concepts, analytical frameworks and examples, which aim at: familiarizing her/him with basic notions related to environment and sustainable development as well as with concepts related to economic, policy and institutional implications of decision-making for sustainable development at the local government level. Moreover, a number of economic tools and methods available to translate the above concepts into practical undertakings are described briefly.

Audience aimed at

A test made in a training workshop in Cameroon, which was followed by the preparation of a case study based on the concepts and tools learned, showed that this publication is particularly suited for training purposes and may serve as a reference tool for officials of the government at the local level, non-governmental organizations, educational institutions, and other organizations and associations who are familiar with basic economic concepts and involved in one or more of the following tasks:

(i) information, sensitization, and training on environmental implications of policies/projects/programmes;

(ii) project and policy analysis extended to environmental considerations; and

(iii) implementation of environmentally sound projects, programmes, policies, and strategies at the local government level.

Though the same concepts could be extended to the community level decision-making, the needs in terms of both decision-making tools and communication approach may differ substantially. A separate publication specifically targeted to the community level is therefore advisable.

Ideally, this publication should go along with a companion volume aimed at: (i) illustrating how the principles, concepts and tools presented here can be operational; and (ii) developing case studies of practical decision-making approaches for sustainable development at the decentralized level.

Structure and content of the publication

The publication consists of five chapters. In the first "*Why caring for the environment*", the role of environmental resources and environmental goods and services in sustainable economic development is addressed. This Chapter presents the main economic issues related to environment, including how mainstream economics could reflect better the role of environment in ensuring human welfare now and in the future.

The second chapter "*Decentralization and environmental issues*" provides a detailed examination of why and how environmental problems can be dealt with at lower administrative levels, particularly local government level. A number of reasons are put forward which justify why local level administrations and institutions are often more effective in addressing environmental problems. It is also pointed out, however, that in some circumstances high level administrations and institutions may be indispensable to solve environmental problems. The conclusion is drawn that the identification of the most suited institutions will depend generally on the specific situations, rather than on a pre-defined procedure.

The third chapter "*Fostering environment in decentralized decision-making*" highlights the role of government administration. A review is provided of the instruments available to the government, both at the central and local level, to ensure proper consideration of the environment in the decision-making process. Three broad instruments are considered: (i) direct investments; (ii) incentives, and (iii) institutions. A decision-making framework is presented,

which is more appropriate to and consistent with the concept of sustainable development than the conventional approach. It is stressed that participation, communication, capacity building, awareness creation, and appropriation of decisions are the main prerequisites of this framework.

Chapter four "*Entry points of environment in decision-making at local government level*", starting from the decision-making framework process suggested in the previous chapter, focuses on the stages of the process that require particular attention to environmental issues. These stages are recognized in: (i) natural resources assessment; (ii) analysis of problems and objectives/priorities setting; (iii) action planning; and (iv) monitoring and evaluation.

CHAPTER 1

WHY CARING FOR THE ENVIRONMENT

1.1 SUMMARY

The main purpose of this chapter is to provide an overview of how environmental goods and services or environmental resources contribute to increase the welfare of societies.

First it presents a **classification of environmental issues** (natural resources and environmental problems) and points out that the choice of the most suited measures and institutional setting to address the environmental problems depends on the type of environmental issues.

Then it examines the **economy-environment interactions** and highlights that environment does not provide only raw materials but also a number of other valuable functions. It discusses the reasons why the goods and services provided by natural and environmental resources are generally underestimated and often do not enter the economic analysis. In particular the following causes are addressed:

- belief, until recently, that **environmental resources are infinite**;
- limitation of the **substitution of man-made capital for environmental resources** argument; and
- capacity of the markets and policies to account for environmental impacts. The issue of **market and policy failures** is examined in detail.

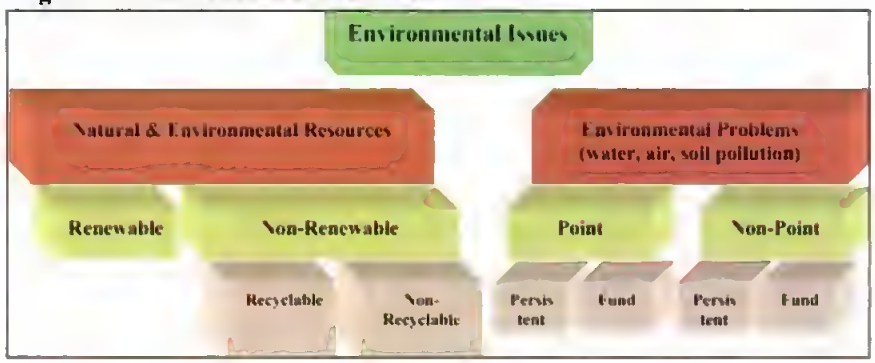
Finally the chapter addresses the issue of **sustainable development** and the role the environment plays in ensuring that future generations are at least as well-off as the present one.

1.2 DEFINING ENVIRONMENTAL ISSUES

To understand better the role and contribution of environment in sustainable development, it is useful to first provide some definitions and classifications of environmental resources and problems. Indeed these general statements encompass a variety of situations, facts, processes, all of which have specific characteristics as well as management and policy implications.

A possible classification of environmental issues is presented in Figure 1.1. Two broad categories are first identified between **natural and environmental resources** and **environmental problems**.

Figure 1.1 Environmental issues classification



Natural and environmental resources

Natural and environmental resources generally describe all the elements available in nature that are used or can be used in the economic system. These can be:

- physical such as soil, water, forests, fisheries, and animals, minerals (e.g. copper, bauxite, etc.);
- gases (e.g. helium, hydrogen, oxygen, etc.); and
- abstract such as solar energy, wind energy, landscape, good air, clear water, and so forth.

Natural and environmental resources can be further split into renewable and non-renewable, and non-renewable in recyclable and non-recyclable resources:

... renewable

- renewable resources are reproducible and in principle could be maintained perpetually. Examples of renewable resources are forests, animals, and water. The availability and reproduction rate of these resources depends generally on their management by humans. The management issue related to renewable resources is the optimal rate of extraction;

... and non renewable

- non-renewable resources on the contrary cannot be regenerated or the regeneration takes place so slowly that it will not increase significantly the stock of resources in any reasonable time span. Examples of non-renewable resources are oil, gas, minerals, and so forth. Non-renewable resources can,

... recyclable

in turn, be divided into recyclable and non-recyclable resources. Recyclable resources such as minerals, paper, glass, do not lose their properties when they are used in economic processes. Therefore they can be reused in the economic system. In theory 100 percent of these resources could be recycled but for economic reasons[1] only a fraction of these are. As for renewable resources, the management question is what is the efficient amount of recycling. Non-recyclable resources are finite in the sense that once used, their stock is no more available for future use. This is the case of energy resources such as coal, gas, oil. The management problem in this case involves substitution with renewable or transitional resources.

... non- recyclable

Environmental problems

Environmental problems are mainly related to the impacts of human activities on environmental resources. These generally take the form of pollution, depletion or degradation of water, air and soil. Soil erosion, water salinity and pollution, desertification, forest depletion, coastal degradation are accounted for as the major environmental problems in the developing countries.

Various forms of pollution exist: point and non-point and persistent and fund.

Point pollution

- Point pollution is generally associated with the possibility of identifying the source of emission and with the limited domain over which its damages are experienced. This would be the case, for example, of wastewater of industries polluting a lake, a river or a coast.

Non-point pollution

- Non-point pollution, on the contrary, refers to a non-identifiably precise source of emission and to a more extended area of its negative impacts. A typical case of non-point pollution is surface water pollution due to various and widespread emission sources, such as industrial and urban wastewater, or use of nitrogen in the agricultural sector. Another example of non-point pollution is air pollution due to the increase of carbon-dioxide in the atmosphere. This pollution is originated by many economic activities (industries, cars, deforestation, etc.) and by many countries (industrialized as well as developing countries).

Stock pollution

- Stock pollution refers to pollutants that cannot be absorbed and are accumulated in the environment. Examples of stock pollutants are lead, many chemicals such as dioxin, and so forth.

Fund pollution

- Fund pollution is given by pollutants that can be absorbed by the environment provided their concentration does not exceed the absorptive capacity of the environment. Among fund pollutants are organic matter, which is transformed by bacteria in less harmful inorganic matter. Carbon dioxide is also absorbed and transformed by plants and oceans.

The understanding of the peculiarities of the various types of environmental resources and problems is of primary importance in the identification of both the most appropriate management and policy measures as well as the most suitable institutional level to cope with them.

[1] The entropy law also explains why only a fraction of recyclable resources can be reused.

1.3 ENVIRONMENT PROVIDES THE RESOURCE BASE FOR LIFE SUPPORT

Environment as a bank

"The bank (environment) is filled with limited amounts of renewable and non-renewable natural assets or capital. Through bank operations, the capital generates interest. An environmentally sustainable society protects the renewable capital, lives-off the interest, and uses the non-renewable capital wisely. In this way massive debt is avoided and the ecosystems are kept running." (Gray *et al.*, 1995).

... it provides

There is now widespread recognition that the environment interacts with the economic growth of economies, and in general contributes to the welfare improvement of societies through three main functions:

... raw materials

(i) it supplies **raw materials** that will serve as inputs in the economic activities processes;

... sink for wastes

(ii) it functions as a **sink for wastes** of any type produced by the economic and human activities; and

... direct utility

(iii) it provides **direct utility** to people.

Its greater relative importance for developing economies

The relationship between environmental resource base and welfare is particularly true for the developing economies. Indeed, in contrast with developed countries, developing countries and particularly the poorest ones depend substantially on renewable resources and on the self-regeneration capacity of the environment. This is mainly due to the fact that technological substitution has not yet developed as in the industrialized countries.

Thus, for example, water pollution is less an issue in industrialized countries than in developing ones because water treatment plants are more widespread, whereas populations of developing countries still rely on water sources (rivers, wells, etc.). Another example is the substitution of fossil fuels for fuelwood in developed countries, whereas wood is still the major fuel source in developing countries. Table 1.1 illustrates the dependence of developing countries on the major renewable resources.

Table 1.1 Some indicators of dependence of developing countries on renewable resources in the 1980s

Countries	Traditional fuel as % of total energy	Excess harvesting of wood over sustained yields
Nepal	93	+132
Malawi	92	+31
Tanzania	91	+151
Ethiopia	89	+150
Sudan	83	+71
Paraguay	83	
Niger	80	+193
Uganda	71	+21
Yemen	58	+300

Source: Various authors.

The economic-environment system can be thought of as a circular economy where stocks and flows of natural resources interact with the economic processes in various ways. This model contrasts with the conventional linear conception which assumes, as depicted in the situation 1 and 2 of Figure 1.2 on the forthcoming page, that the natural resources serve the purpose of production processes (P) for both consumption (C) or capital creation (K)[2], which in turn create utility or welfare[3].

1.4 ENVIRONMENTAL RESOURCES ARE SCARCE

The earth is finite

> "Its ability to absorb wastes and destructive effluent is finite. Its ability to provide for growing numbers of people is finite. And we are fast approaching many of the earth's limits. Current economic practices... cannot be continued without the risk that global systems will be damaged beyond repair. Pressures from unrestrained population growth puts demands on the natural world that can overwhelm any efforts to achieve a sustainable future."[4]

Excessive use of renewable resources

Renewable resources (soils, vegetation, water) are being used in excess of their regeneration capacity, thus resulting in the depletion of stocks, the reduction of many functions of the environment, and consequently in decline of welfare[5]. This is due mainly to the fact that in the course of time, population growth and per capita consumption expansion have led to an increase in both the use of natural resources and the production of wastes, thus determining the rising importance of the economic system relative to global environmental resources[6].

This is illustrated in Figure 1.3, where the scale of the economic sub-system (production P and consumption C systems) increases, whereas the terrestrial ecosystem capacity of providing raw materials to the economic system (RM) and to absorb wastes generated by economic activities (W) decreases.

[2] Capital goods are not considered here for matter of simplification of the presentation.

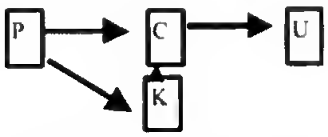
[3] Pearce and Turner (1990), Serageldin (1996).

[4] Declaration signed by 1 575 scientists, including 99 Nobel Prize winners, reported by the Times Magazine in 1992.

[5] According to some estimates resource degradation due to biomass losses in some African countries could be costing as much as 9% of GNP (Burkina Faso, Lallement 1990). Soil erosion, deforestation, and water pollution in Nigeria amount to 17.4% of GDP (the World Bank, 1991). A study by Repetto *et al.* (1989) reports that depreciation of forests assets in Indonesia accounts for around 3.6% of GNP. In Costa Rica, deforestation costs sum up to 7,7% of GNP (World Resource Institute, 1991).

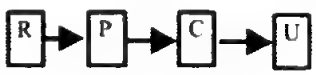
[6] According to some authors (Speth, 1989), it took almost 1900 years to attain a US dollars 60 billion scale economy, but today this amount is produced in only two years. If this path remains unchanged, he maintains, the present US dollars 20 trillion economy may be five times bigger in only one generation.

Figure 1.2 Environment-economy interaction



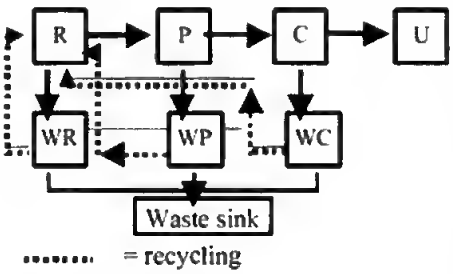
1. Linear concept of the economy

Production processes generate goods that can be either consumed (C) or invested (K). In the long term, K is also consumed. Therefore K can also be assumed to be consumer goods and will disappear from the subsequent models. Both C and K create utility (U).



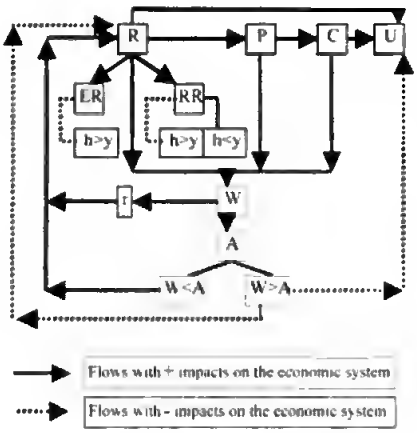
2. Raw material supplier

To produce goods, raw materials are required. These can be exhaustible (oil, coal, other minerals) or renewable (forests, water, solar energy, and so forth). All of them are provided by the ecosystem.



3. Waste absorption

All the components of the previous model produce wastes. Some of them can be recycled (glass, aluminium, paper and so on) but most of them are not and are assimilated (absorbed) by the environment (air pollution, industrial effluents, etc.). Environment is assumed to have a finite *absorption capacity*. If wastes are higher than the absorption capacity, the resilience of the environment will be affected negatively and the economic function of the environment as waste assimilation will be reduced.



4. Circular concept of economy

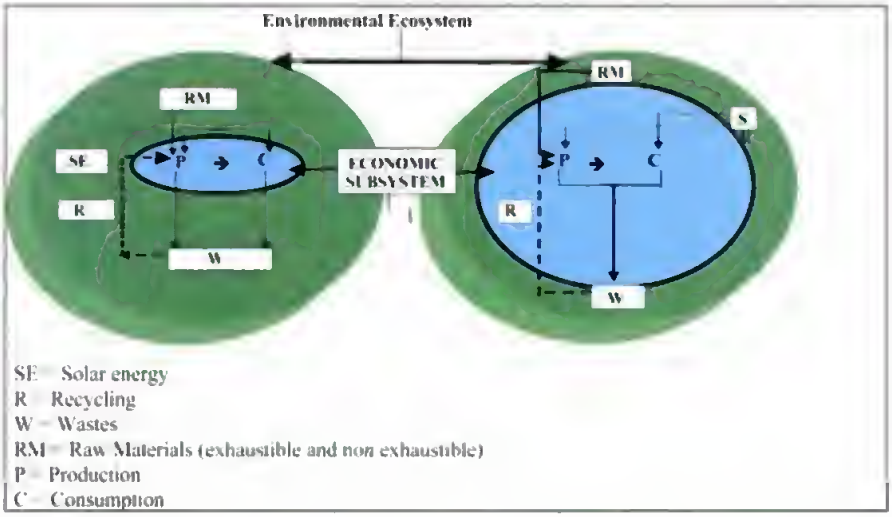
Environment also provides direct services to consumers such as aesthetics, recreation, etc. The model beside depicts the functioning of a circular economy incorporating the economic functions of the environment.

Legend

A = Assimilation
P = Production
C = Consumption goods
K = Capital goods
U = Utility
R = Natural Resources
W = Waste Products
r = Recycling
ER = Exhaustible Resources
RR = Renewable Resources
y = Yields
h = Rate of harvest

Source: Pearce and Turner (1990).

Figure 1.3 Growing economic system compared to the environmental ecosystem



Two major views on finite resources

The question of finite availability of natural resources has been addressed by various thinkers advocating two main broad views.

...ecosystem threatened by present economic growth model

The first[7] claims that the increasing economic subsystem (internal sphere in Figure 1.3) relative to the environmental goods and services provided by the ecosystem is putting environmental resources under stress, and that their supply is becoming limited in relation to the demand. This occurs for raw materials but also and increasingly for the sink and the amenity services of the ecosystem. Though some of these limits can be overcome (for example, substitution of solar energy for oil based energy), many of them are not (for example, landfills) and will pose a real threat to welfare improvement (Box 1.1). As a conclusion, it maintains, the present model of economic growth is conflicting with environmentally sustainable development.

Box 1.1 The economic concept of welfare

Welfare is often used interchangeably with well-being and utility. The economic concept of welfare can be related to the definition of income articulated by Sir John Hicks (1947), who maintains that a man's income can be defined as "*the maximum value, which he can consume during a week, and still expect to be as well off at the end of the week as he was at the beginning*". Following the above definition, welfare decrease or increase is generally measured as the amount of goods and services consumed by households in one year divided by the population to obtain the *consumption per capita*. If consumption per capita increases, then the average member of the population is better off; if consumption decreases, then the average member of the population is worse off.

[7] Meadows (1974) and, subsequently, others such as Rees (1990), Daly (1991), Ehrlich and Ehrlich (1990), Hardin (1991), Goodland (1991).

Box 1.1 (*cont.d*)

Several objections have been raised, however, to this measure of welfare. The two most important are that: i) the standard national account system, from which consumption indicators are derived, fails to account for the depreciation of natural capital and; ii) does not account for equity or income distribution, thus leading policymakers to undertake unsustainable development strategies.

Depreciation of natural capital

For human-made capital (dams, roads, buildings, plants, etc.), national accounts set aside an amount called depreciation to compensate for the decline in value as the capital wears out; no increase in economic activity is recorded as an increase in income until depreciation has been subtracted from gross returns. No such adjustment is made in the national accounts for natural capital. It follows that we can deplete our natural resources and the associated economic activities will be recorded only as income, not as a decline in natural capital endowment.

Income distribution

According to economic theory, welfare is maximized when *Pareto efficiency* has been achieved, that is when welfare of some individuals has increased without making anyone else in the society worse off. The most severe limitation of the Pareto principle is that it is related only to an individual's welfare, not to the relative well-being of individuals. Therefore, it does not account for the situation of increasing income gap between poor and rich. Efficiency is attained provided that the net gain of welfare in society is positive.

To cope with these flaws, a number of studies have been carried out attempting to adjust welfare measures and new indicators have been constructed. The most important is the measure constructed in 1990 by the UNDP, the Human Development Index (HDI), which is based on three major components: longevity, knowledge, and income. Other indicators (World Report on Human Development, 2000) based on the same components have also been constructed to take account of social and environmental concerns, namely the Human Poverty Index (HPI) and the Human Development Sex-specific Index (HDSI).

The second puts forward a more optimistic view[8] arguing that economic growth remains feasible without necessarily exhausting natural resources because:

... economic growth is compatible with maintaining natural resources

(i) *technological progress* allows the replacement of renewable resources for exhaustible ones as well as the reduction of the quantity of natural resources required per unit of economic output;

(ii) there is the possibility of *substitution of man-made capital for natural capital*, though within some limits (Box 1.2); and

(iii) *new sources* of exploration are possible.

[8] Solow (1974 and 1986), Stiglitz (1974), Dasgupta and Heal (1979), Pearce and Turner (1990).

It is argued, however, that the above is possible on condition that the price system reflects the real total value (i.e. the value incorporating all the value components of environmental resources and adjusted for the market failures; see Section 1.5.3 for more details) of the goods and services used and produced by the economic system, including those supplied by the environment.

Box 1.2 The limits of substitution of man-made capital for natural capital

Mainstream economists, though recognizing that some resources, particularly exhaustible resources are scarce, argue that technical change and substitution of man-made capital for natural capital could secure economic growth without depleting the natural environment. They suggest that what matters is that overall capital stock (natural plus human and man-made capital, including operating capital such as fertilizers and chemicals) of the economic system is not depleted. Therefore natural capital can be replaced by man-made capital so long as the social rate of return of man-made capital is higher or at least equal to natural capital. So, for example, deforestation can be allowed if the development project secures a higher social rate of return than the services provided by the forests.

This argument may not always hold for the following reasons:

- the **degree of substitutability** between the various types of capital may vary considerably from perfect substitutability (for example, between two types of natural capital such as coal and oil), to imperfect substitutability (for example, between natural capital and man-made capital such as soil nutrients and fertilizers) and non-substitutability (for example, it is difficult at least in the short to medium term to imagine how man-made capital can substitute for the ozone layer);
- **the proceeds of exploitation of natural resources are seldom reinvested totally in man-made capital.** A proportion of the proceeds is often consumed, thus leading to additional depletion of the environmental resources through waste generation. If these impacts are not accounted for the value of net capital stock may decrease;
- **man-made capital requires that other natural resources be used for their construction** (Perrings, 1987). So for example, production of chemicals is energy demanding. Similarly to the previous point, if the value of these resources is not incorporated in the assessment of costs and benefits, net capital stock value will decrease. This fact contrasts with the substitutability idea and is more consistent with the complementary idea suggested by the Brundtland Commission (Brundtland Commission, Our Common Future, 1987);
- **knowledge of ecological processes is not yet perfect** (for example, the way in which forests protect soils, regulate water flows or affect the climate, is not yet well understood), therefore we cannot be sure how man-made capital can substitute for all forests' functions; and
- **some natural resources cannot be substituted for by man-made capital because either it is considered immoral or the benefits of the man-made capital should be infinite.** This is the case when substitution involves the irreversible destruction of natural capital stock. In this case, substitution can be viewed as immoral because it leads to the destruction or extinction of habitats and animal species and it entails that man-made capital benefits be infinite because the natural stock replaced is lost forever.

Since prices reflect the scarcity value of goods and services, the advocates of this view also recognize implicitly that environmental resources are limited.

Disregarding the different emphasis placed on how limited environmental resources are and, particularly, the policy implications of their conclusions, the various schools of thought acknowledge that the scarcity of the quantity and the degradation of quality of environmental resources have increased dramatically in the last decades, particularly in the developing countries, and that environmental considerations in decision-making are far more important today than past economic management assumed.

1.5 MISESTIMATION OF ENVIRONMENTAL VALUES CAN IMPAIR ECONOMIC GROWTH

One of the reasons why environment is seldom considered in policy appraisal stems from the fact that environmental goods and services are not marketed and therefore do not have prices that can be comparable with development costs and benefits. Economic theory explains the absence of markets for these goods and services with the market and policy failure arguments.

1.5.1 Market failures

The dominant economic theory maintains that free and perfectly competitive markets[9] will lead to optimal allocation of resources, including environmental goods and services, or to economic efficiency.

Reasons for market failures

Market failures are defined as those circumstances that prevent the perfect competition, and therefore economic efficiency, from being achieved. The major sources of market failures related to natural resources are summarized below.

- externalities;
- public goods;
- property rights;
- ignorance and uncertainty;
- short-sightedness; and
- irreversibility[10].

[9] Perfect competitive markets means that markets are characterised by a large number of buyers/consumers and sellers/producers who are perfectly informed and engage freely in transactions for private goods. As it is pointed out in this section, these conditions are often missing in the markets of both developed and developing countries.

[10] For a more detailed discussion on this issue the reader is referred to Buchanan and Stubblebine (1962), Dasgupta and Pearce (1972), Ward *et al.* (1991), Carlson *et al.* (1993), Panayotou (1993).

Externalities

... positive and ... negative

Externalities occur when an economic activity affects technology, consumption, or preferences of someone who is neither the producer nor the consumer (i.e. a third party). These effects can be either positive or negative[11]. In the first case the third party will be better off and in the latter it will be worse off. In neither case externalities will be included in the financial price paid for the good produced. In other words, the market does not signal the costs/benefits of externalities to the perpetrator, who will therefore not change his/her behaviour accordingly.

An example of negative environmental externality (sometimes also called external diseconomy) is the case when the aerial dispersion of sprays applied by farmers contaminate nearby livestock operations, increasing their production costs in the form of additional veterinarian's bills and medication.

The perpetrator of environmental costs will not be informed by the market about the costs generated to livestock producers, so he/she will not receive incentives to reduce pollution. The existence of externalities prevents achieving the optimal allocation of resources in that they provide wrong signals as to where should the resources be optimally allocated. In the example above, it might be that if farmers were obliged to internalize the pollution costs generated, the resources would be allocated to alternative and more efficient uses. For the environment, externalities may occur only in the future, thus affecting future generations. Yet, the links between humans and environment are often not known *a priori* nor can the preferences of future generations be known vis-à-vis environmental resources. In general, only when environmental damages occur do these linkages become known. Therefore this kind of externalities would be better treated in the context of uncertainty.

Public goods

Though environmental goods and services are frequently defined as public goods, this section will demonstrate that their belonging to one or another category of goods may vary according to the circumstances. As is shown in Table 1.2 below, goods and services are generally divided into four categories on the basis of two main characteristics: excludability and rivalry.

Table 1.2 Goods and services classification

		Excludability	
		High	*Low*
Rivalry	*High*	Private Goods	Common Pool Goods
	Low	Toll Goods	Public Goods

Excludability relates to a situation where consumers who do not meet the conditions set by the supplier of the good/service are excluded from using (consuming) it.

[11] Though this work considers mainly negative environmental externalities, the same analytical approach can be used for positive environmental externalities.

Rivalry relates to a situation where one person's consumption of the good/service comes at the expense of another person's consumption. So, if one person uses the good/service another person cannot use the same good/service.

Private Goods: goods for which there is high rivalry and high excludability. Moreover, private goods are also generally divisible in smaller exchangeable units (e.g. square meter of land).

Common Pool Goods are resources used by multiple individuals regardless of the type of property rights involved. Excludability for such goods and services is low but rivalry is high. Examples are common land, fisheries, wildlife, and rivers.

Toll Goods (also called *Club Goods*) are non-rivalrous, at least up to the point where capacity constraints may influence the marginal cost of further provision, but which are excludable. A typical example is roads, but national parks could also be considered toll goods.

Public Goods[12]: goods and services that are non-excludable, non-rival, and indivisible. In other words public goods are goods and services that each individual can consume simultaneously in equal amounts. Typical examples are public information, defence.

The identification of the category the good belongs to is very important because it will influence the institutional arrangements determining the behaviour of individuals/societies towards the use of natural resources. For example, the most appropriate institution for private goods is the market, where individuals will exchange them on a voluntary basis. The behaviour towards public goods will generally be influenced by command and control mechanisms determined at the highest hierarchical level. Common pool goods use is based on the common interest principle.

Environmental goods as public or common pool goods

Most of the environmental goods and services belong to the category of public goods or common pool goods either because they are non-excludable and non-rival or because they are non-excludable but rival.

To the **first category** belong, for example, sunlight, weather, biodiversity, flood control services of forests and coral reefs. Other environmental services are also generally classified as public goods, notably: scenery, clean air, clean water. However, the latter services can be subject to increasing rivalry or excludability as they approach a congestion point. Beyond this point they may assume the characteristics of either common pool, toll, or private goods and services.

[12] Public goods (sometimes also called collective goods (Johansson, 1991) have also a third property, namely **indivisibility**. That is, public goods cannot be broken down into individually consumable units.

Take, for example, the case of an open access site with **charming scenery**. As long as the number of visitors enjoying the site is low, scenery service of the site can be considered a public good. If demand for the site increases, congestion problems may arise and users' benefits decrease up to a point where marginal costs become higher than marginal benefits, which will push many users to search for alternative sites. Moreover, if the number of visitors exceeds the carrying capacity of the site, degradation effects will most likely occur. This scenario would suggest a situation much closer to common pool goods than public goods.

Take now the example of **clean air** (a similar reasoning holds for clean water too). Nobody can be excluded from using good quality air. As long as the supply of good air is abundant and users are few, this environmental resource can be considered a public good. But think about a big city where clean air is a privilege of only few residential areas located near gardens. Most likely the prices of houses/apartments in these areas will be higher than houses/apartments with the same characteristics but located in an industrial area. The difference of prices reflects the value of clean air individuals/households are willing to pay to benefit from good air. The fact that individuals/households are willing to pay some money to benefit from clean air means that this good is excludable (i.e. only individuals/households willing to pay the price of clean air will be allowed to benefit from it, while all the others will be excluded). In this case, the characteristics assumed by the good in question are much similar to a toll good.

... or toll goods

The **second category** includes all the renewable natural resources, notably forests, water, wildlife, fisheries. It is worth pointing out here that many times this category of resources is used interchangeably with *open access* resources or *common property resources*. The latter categories entail a property right regime regulating the access and use of the natural resources. **Open access** resources entail that no common rules at all exist regarding the access to and use of common pool resources. **Common property** resources, on the contrary, are subject to property rights based on enforceable rules all the users agree upon and comply with. The degree of exploitation and degradation of common pool goods is very much dependent on whether a property rights regime exists or not, and on the effectiveness of the rules and rights established.

In the extreme case of an open access resource, say grazing land, the use by one herder will not exclude the same use by another herder. If herders behave rationally (i.e. if they aim at maximizing their profits) they will use as much as they can of the environmental resource (herders, for example, will bring to the grazing area the highest number as possible of animals and leave them on the area as long as possible) for the simple reason that the exploitation cost of the resource is zero. It is clear that by doing so the grazing land will deteriorate very quickly. But, since the herders have no incentive to reduce their use of pasture they will not change their behaviour and land will be overexploited. This case, which is often referred to as the Tragedy of the Commons (after the article by Garret Hardin[13]), highlights the problem of the property rights

[13] Hardin (1968).

discussed in the following section. An economic analysis of the reason why open access resources may not lead to efficient exploitation is provided in Appendix 1.1.

Property rights

Property rights are any kind of legal acts defining the rights of individuals to use natural resources. These rights can be ownership rights, lease, or use rights conferred by law (e.g. the right to use water passing over one's property). The underlying assumption of the property rights argument is that well defined, exclusive, secure, transferable, enforceable, and clear property rights allow to create markets for public goods and externalities, and consequently to place an economic value (price) on them. If the above conditions are not met, like in the open access situation, the incentives to conserve, protect, and manage natural resources in a sustainable manner will be undermined.

According to Wade (1986), the need of property rights is tightly linked to the perception of ecological risk. The higher the risks of degradation of the natural resources, the more incentive there is to manage them collectively and to create rules ensuring the rights as well as the duties towards the resource.

Let us take the case of farmers disposing their waste waters in a lake. The absence of property rights will generate a situation where farmers believe that they have the right to pollute. Let us assume now that water is also used by recreationists who are claiming the right to use clean water for swimming. A conflict will emerge between the two parties on who actually has the right on the resource. If conflicts are not settled, the natural resource (i.e. lake) will deteriorate very quickly because all polluters will behave as in the open access situation. If, on the contrary, the parties involved are aware of and concerned about the value of the resource and the risk of deterioration, they will concur in the definition of rules toward the access to and use of the lake. Whatever the instrument used to overcome the dispute (negotiation, government intervention with laws or economic incentives, courts), the outcome will be the setting up of property rights.

In South India, for example, landowners often have rights to their crops but not to the stubble left after harvesting. The village establishes rules for the grazing of the stubble land, including, for example, charging for grazing and paying for the manure that these herds generate. Outside herders come to an agreement with the village authorities and some grazing rights are even auctioned to the highest bidders. And if some crops are still standing, and are at risk from the grazing, additional rules of behaviour are sought and guards are posted[14].

The problem of property rights is particularly important in developing countries where modernization of the tenure systems in agriculture has often been accompanied by the removal of local traditional and custom-based rights to the use and management of environmental resources, without substituting them with effective alternatives. The disruption of traditional tenure and management systems have in many cases led to situations very close to open access resources, and therefore to overexploitation of resources.

[14] Wade (1986) as reported by OECD (1994).

An example of a similar risk is reported by a WWF and OXFAM study[15], which highlights that following the establishment of the free trade area between Canada, Mexico, and United States (NAFTA), social disintegration and decay of traditional social institutions charged with managing communal grazing land have had various negative environmental, economic and social impacts. From the environmental viewpoint, overgrazing and erosion have become the major problem. From the economic point of view, poor maize producers who benefited from access to communal grazing have seen their benefits progressively eroded. Moreover, reduced maize prices due to the higher competition with maize produced in the United States, mean that poor producers have to rely more and more on wood gathering as a source of fuel for heating and cooking. From the social point of view, migration and unemployment have increased substantially.

Ignorance and uncertainty

Ignorance and uncertainty may also hinder the functioning of markets. The limited knowledge of some environmental processes does not help providing the users of natural resources with the required information on the possible impacts in terms of quantity, quality and time of occurrence in order to adjust their behaviour.

Short-sightedness

Short-sightedness adds on the market failures in that individuals or countries (particularly those belonging to the lower income groups) have usually short time horizons, thus preferring investments yielding benefits in the short to medium term rather than in the long term. In other words, the marginal value of a US dollar one now is worth more than the same in the future. This time preference is reflected in positive discount rates of benefits generated in the future (Box 1.3). The effect of positive discount rates is that the present value benefits occurring in the future will be less attractive than the benefits obtained in the short term.

Box 1.3 Discounting the future benefits and costs

Discounting[1] is the computational technique that measures the preference of the individuals for the present. It calculates the velocity of loss of value of money in the future. The larger the discount rate, the higher the velocity of loss of value. So, for example, a discount rate of 10 percent to a benefit of US$10 received in 10 years time will be worth US$3.85 now. If the discount rate is 3 percent, the same amount of money received in 10 years time will be worth US$ 7.44 now. The formula to calculate the present value (the value now) of the benefits received in the future is:

$A*1/(1+i)^n$ where: A = amount of money received; i = discount rate used and; n = the year the amount will be received from now. In the examples above, the formulas will be:

$$US\$10*1/(1+0.1)^{10} = US\$3.85 \text{ and } US\$10*1/(1+0.03)^{10} = US\$7.44$$

[15] Nadal Alejandro (2000).

Let us assume that we have to decide between two possible options for rehabilitating an abandoned area: the first is an industrial development project; the second is reforestation. The industrial plant will most likely yield benefits in the first years, whereas the investment in reforestation may generate benefits only after 30 years. Let us assume for simplicity that both projects yield the benefit in one shot but in different years: the industrial plant in Year 3 and the reforestation project in Year 30. We assume also that the net benefits of the industrial plant are worth US$3 000 and those of the reforestation project US$15 000.

With a positive discount rate of 8 percent, the present value of the two investments, using the formula of Box 1.3, will be US$2 381 and US$1 491 respectively. It follows that despite the higher benefits generated by the reforestation project, the industrial project has a higher present value. The above example explains why environmental investments are seldom put first in the development agenda.

Irreversibility

Irreversibility is a typical element of environmental market failure. Some development investments may determine the irreversible loss of natural assets both for the present and future generations. This will reduce the options available to future generations to use the asset in question. Since preferences of future generations cannot be known, it is difficult to state whether it is worth destroying forever one resource or conserve it.

How to overcome market failures:

Market failures can be overcome either through direct negotiations between the parties involved or through intervention of the government at both the local and central level. In both circumstances, the estimation of the economic value of natural resources and environmental impacts of investment projects can facilitate the task (this topic is addressed in Section 1.5.3).

...negotiation among affected parties

(i) *negotiation* among the affected parties usually happens when there is a small number of parties involved and the cost of transactions is low. Transaction costs are the costs incurred to reach an agreement. If these costs are higher than the expected benefits of the agreement, the deal will fail. Possible transaction costs are the time necessary to get the parties together, the absence of clear information on benefits obtainable and costs incurred, the difficulty of enforcing the agreement, and the difficulty of establishing how to implement the agreement. Examples of possible conflict resolution through negotiation are provided in Chapter 2.7.

... government intervention

(ii) *government*[16] *intervention* at the central or local level generally takes the form of economic incentives and command and control measures aimed at modifying the behaviour of agents towards the use of the environmental goods and services. A multitude of economic incentives are ownership rights, taxes, tariffs, charges, fees, royalties, subsidies,

[16] The term government here means anybody to which the society has given the power to regulate behaviour or apply penalties for not complying with the regulations. It may therefore stand for any sub-national level board in charge of deciding, for example, charges for irrigation water, water distribution calendars, etc.

tradable permits, green funds, deposit refund systems, and environmental bonds; among command and control measures are norms, standards, and regulations. A more detailed description of these tools and their effectiveness in the developing countries is provided in Annex 1.

1.5.2 Policy failures

The rationale behind government intervention is the existence of the above mentioned market failures, and the concern about both the distribution of market outcomes and the social morality of markets. In other words governments intervene to achieve efficiency objectives (internalize externalities in the production processes, define property rights, etc.) as well as non-efficiency objectives such as income distribution between social groups and regions (equity issue), poverty alleviation, moral achievements such as avoid that market mechanisms can "justify" markets of immoral goods and services (for example, health-affecting construction materials, introduction of uncontrolled genetically modified varieties etc.), political consideration such as strategic food stocks, and so forth.

Sometimes, however, government interventions have contributed to the mismanagement of natural resource by providing the wrong signals to individuals and firms. Many examples can be cited of distortions in the allocation of natural resources induced by poorly designed government interventions.

Examples of policy failures

Some of the major sources of policy failures affecting the environment in developing countries are generally attributed to:

(i) low tariffs of environmental resources' use, such as irrigation water;

(ii) subsidized energy-intensive inputs, such as fertilizers and pesticides;

(iii) poorly designed property rights;

(iv) poorly designed investments;

(v) credit subsidies for environmental depleting activities (e.g. ranching);

(vi) low royalties on natural resource mining; and

(vii) nationalization of natural resources can also be a policy failure in certain cases, notably when high transaction and management costs are involved. This is the case, for example, of forest resources of many developing countries where governments are unable to control access to forest lands under public ownership and lack financial resources for efficient management of forests. In Nepal, where the government recently decided to change the forest property regime and protect forests as a state-owned resource, this policy, which excluded communities from the management of the forests, modified land use incentives and led individuals and communities to view state-owned forests as open-access resources[17].

[17] Pradhan and Parks, in Hanna and Munasinghe (1995).

Pricing natural resources

1.5.3 Pricing of natural resources: the total economic value concept

Values of environment are not fully known

> "There is much uncertainty about possible economic uses of many non-wood forest products. A number of tropical fruits, nuts, and medicinal plants sold only in local markets, or not at all, may have export potential provided research is done on their properties and proper market development takes place. The ignorance of all the possible values of forest resources and sometime the impossibility to place an economic value on them impair the ability to promote efficient resource management. Undervaluation of forests in developing countries has caused governments to assign a low priority to the forestry sector because of its apparently low contribution to gross national product." (Sharma, 1992).

As was stressed in the previous paragraphs, though a general agreement exists on the fact that environmental resources have a scarcity value, their goods and services are not priced. In addition, their value is generally underestimated due to lack of scientific knowledge and data on all the possible services they can supply, thus determining a policy bias in favour of competing uses of these resources.

The issue of total economic value of natural resources was first addressed by Weisbrod in 1964, and Krutilla in 1967, two environmental economists who proposed a classification of economic values, which encompass some of the major externalities of natural resources exploitation. Although there is not yet complete agreement on this classification[18] it is widely accepted that two broad categories of values exist: "*use values*" and "*non-use values*".

Use values

Use values are the benefits that derive from the actual use of the natural resources. Forest, for example, can be managed for providing benefits such as erosion prevention, recreation, landscape view, etc. Use values are sometimes further divided according to various authors in:

(i) *primary values* or marketed goods and services or also consumptive value; and

(ii) *secondary values* or non-marketed goods and services[19], including ecological benefits, that is those services provided by forests that contribute to the preservation of ecological integrity (such as soil, water and air quality).

[18] Other classifications have been devised, for example, by Filion (1993), Sarker and McKenney (1992), McNeely *et al.*(1990).

[19] Pearce and Turner (1990); Young (1991); OECD (1994); Sharma (1992); Bateman (1993a), Pearce and Warford (1993).

Non use values or existence value

Non-use values correspond to those benefits which do not imply a contact between the consumers and the good. That is, people do not require to use the good they are willing to pay for. One example is the willingness of people who will probably never visit Africa to pay for the protection of elephants in Afriea (Wes *et al.*, 1989). Non-use values are by many authors also defined "*existence value*". The arguments behind existence value are intrinsic value and bequest motive:

Intrinsic value

(i) *intrinsic value* relates to the existence of a landscape or a particular habitat (i.e. the satisfaction of preserving the forest for itself and not as a function of any human use); and

Bequest value

(ii) *bequest value* involves altruism such as, for example, the desire to preserve forests for the enjoyment of other people both now (intragenerational) and in the future (intergenerational).

In addition to these values, environmental economists have introduced another value: the option value.

Option value

Option value is the value placed on environmental assets by those people who want to secure the use of the good or service in the future. The classification of this value is controversial in so far as some authors consider it as a use value, whereas others regard option value as a non-use value. Option values can be either positive or negative.

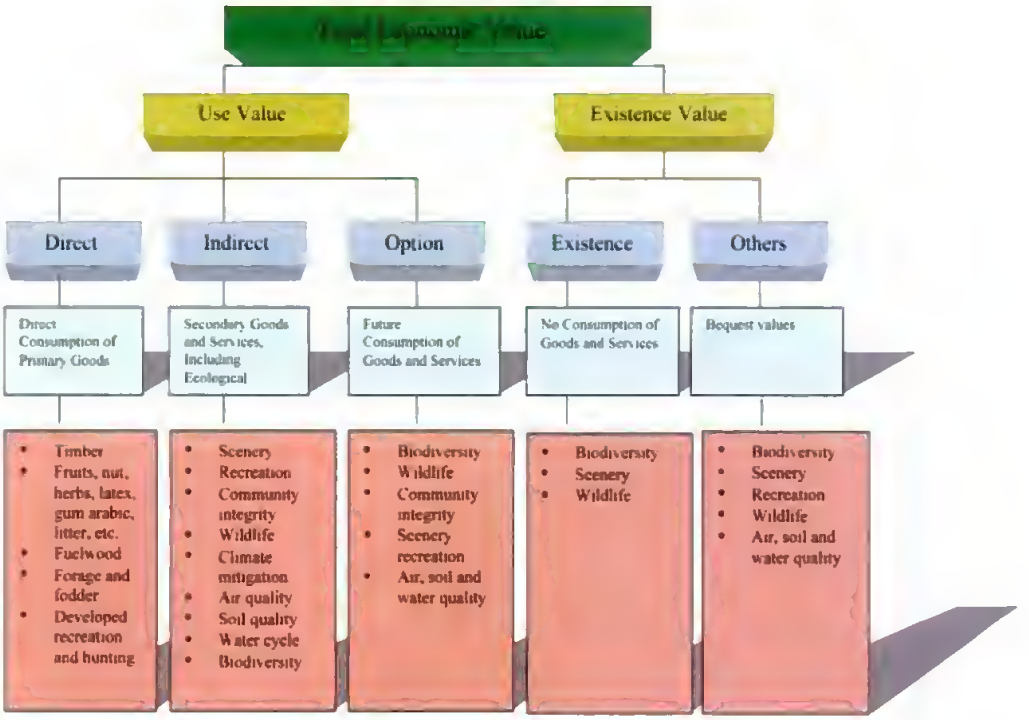
Figure 1.4 provides an illustrative but incomplete list of the values usually attributed to forests by the economists[20].

Total value

The total value of an environmental asset is therefore obtained by summing up all the value components: use values, including option value, and existence value. Of course when summing up the goods and services, caution should be used in order to avoid double-counting. Indeed, before proceeding with the aggregation of these values, the analyst should be sure that they are not mutually exclusive (for example, benefits of clear-felling cannot be added to recreation or soil protection) or that they are not already captured by other value components (for example, option values can be captured partly by use values and existence values).

[20] Ecological economists suggest a different classification, where life-support and ecological values are considered primary services and consumptive and non-consumptive goods and services are secondary. In substance, ecological economists invert the classification of mainstream economists by placing higher importance on *ecospheric values* such as sunlight, lithospheric energy, soil, water, landforms, climate, atmosphere, and organisms, to which it is difficult to assign monetary values.

Figure 1.4 Total economic value of forests



Assume, for example, that a railway line is planned to pass through a valuable forest area and will cause its destruction. Whether the development project is worth doing will depend on an accurate analysis of the flow of costs and benefits it generates. The formula for cost-benefit analysis is:

$$\sum (B - C \pm E) \frac{1}{(1+i)^n} \geq 0$$

where: B are the benefits of the development project, including generally the primary goods of Figure 1.4; C are the development costs (investments and operating); E are net environmental costs or benefits, including secondary and ecological goods and services, as well as option values and existence values; i is the discount rate and n is time.

The problem exists however of how to place an order of magnitude/importance on these values. Ideally these values should be expressed in monetary terms so that they can be compared with all the other costs and benefits of policy decisions. In practice, as already mentioned, many environmental goods and services cannot be priced. In the past decades, several tools and techniques have been developed to measure the total economic value of natural resources. These

are both monetary techniques and non-monetary techniques. A brief description of these is provided in Annex 2.

1.6 THE SUSTAINABLE DEVELOPMENT MOTIVE

With the publication of the Brundtland Report (Our Common Future, 1987), which brought the term "sustainable development" into common use, and the conclusions of the United Nations Conference on Environment and Development (UNCED) - the Earth Summit - of 1992, it has been made clear to the whole world that without better environmental and social considerations (both intragenerational and intergenerational) in decision-making, development would be undermined. The definition of sustainable development suggested by the Brundtland Report placed particular emphasis on needs and intergenerational equity:

Sustainable development

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Though many interpretations have been put forward for this term and other definitions have been added, thus making the real meaning of the concept still somewhat elusive[21], all definitions available suggest that sustainable development cannot be achieved unless two major aspects are addressed in development strategies:

(i) the profound interrelationships existing between the three main goals of development are accounted for (i.e. economic efficiency in the allocation of scarce resources, equity in the distribution of resources, and conservation of the natural environment); and

(ii) the necessity to ensure that the future generations have at least the same development opportunities as the present one.

The definition adopted by the FAO highlights these points by stating that:

Sustainable development is "...the management and conservation of the natural resources base, and the orientation of technological and institutional change, in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development (in the agricultural, fisheries and forestry sectors) conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable".

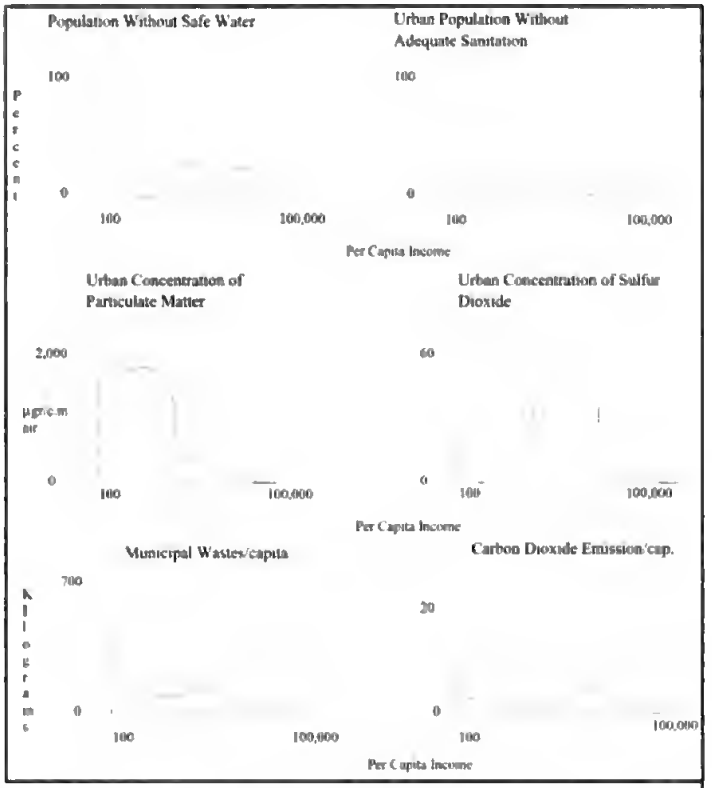
It is implicitly argued in this statement that each single dimension (economic, social, and environmental) has a cause-effect relationship with the other two and that according to the circumstances, these can be conflicting or

[21] For a more detailed discussion on this concept the readers are referred to Barbier (1987) and Pezzey (1992) who provide a valuable review of the many possible interpretations and definitions from the viewpoint of economic theory.

complementary (see Box 1.4). For example, it is possible that environmental and social gains of a new water supply scheme that provides clean water to the poor is achieved at the expense of increasing costs. In this case efficiency goal may conflict with social and environmental goals, whereas social and environmental goals are complementary. It might also be that a solution is found whereby the new water scheme improves economic as well as environmental and social goals. This case would be the win-win situation for sustainable development.

Box 1.4 Environmental degradation-economic growth: two antagonist or complementary goals?

Most of the debate on the interactions between environment and economic growth has focused on the question whether these two dimensions should be considered alternative or complementary goals. The evidence shows that this cannot be stated unless other elements are accounted for in the analysis of the interactions. Among these are: the scale and the structure of the economic and the social systems, the technology, the efficiency with which natural resources are used. For example, efficient management of natural resources using appropriate technologies will reduce environmental impacts per unit of output. Depending on the type of natural resource, economic growth may help solve environmental problems. The World Development Report 1992: Development and Environment, reports, for example, that water pollution problems and related health effects decline as incomes increase. The same happens with particulate and sulfur dioxide levels in the air, although air pollution may increase at early stages. On the contrary, emissions of carbon and nitrogen dioxides worsen as income increases. The figure beside provides an idea of these interrelationships observed by the World Bank[22].



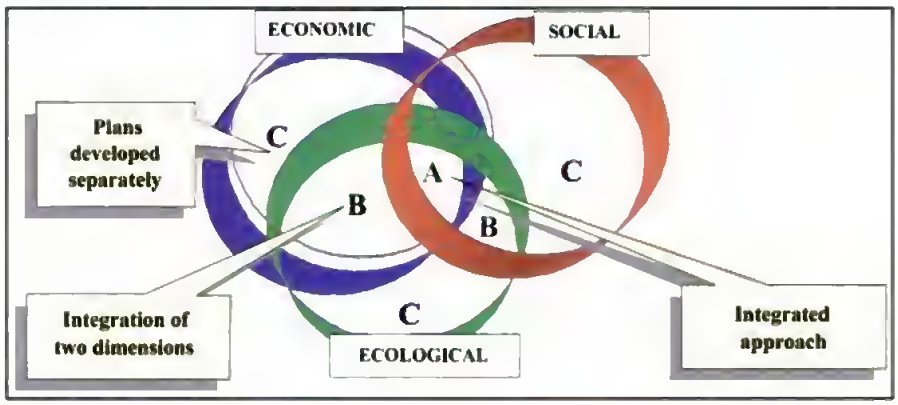
[22] Similar results have been obtained with other studies well documented in Goldin *et al.* (1995).

The understanding and measurement of these interactions are indispensable for proper decision-making. For example, it is now recognized[23] that there is a causation relationship between environmental degradation and underdevelopment and that many environmental problems in developing countries originate from the "lack of development, that is from the struggle to overcome extreme conditions of poverty"[24].

In short, sustainable development entails a decision-making approach based on a continuous and dynamic configuration of trade-offs between the three dimensions (economic, social and environmental) rather than on the optimization of each one of them.

This means that if the goals pursued by the development strategy are conflicting, a choice must be made as to which objective should receive the priority. An illustration of the various levels of integration of economic, social, and environmental issues in decision-making is provided in Figure 1.5. The optimal approach to decision-making for sustainable development lies in the intersection area (A in the Figure) between the three dimensions (economic, ecological, and social). In reality, however, it is rare that an approach integrating the three dimensions is used. More often, development plans are designed taking into account one (area C in the Figure) or, at the best, two (area B in the Figure) of the three dimensions simultaneously.

Figure 1.5 Three dimensions for sustainable development



The problem remains of **how to translate theoretical definitions into practical terms**. The most widely accepted practical implication of the sustainable development concept is that renewable natural resources should be used at "rates within the capacity of renewal" (IUCN/UNEP/WWF, 1991) or, in economic terms, "spending interests and not the principal" (Robinson, 1993). Other possible criteria are listed in Box 1.5.

[23] Myrdal (1968), Chambers (1986), the World Bank (1985).
[24] Bartelmus (1986).

Box 1.5 Criteria for sustainable use of environmental resources

(i) Extraction rates of renewable resources should not exceed regeneration rates

(ii) Non-renewable resources should be replaced, to the extent possible, by renewable resources and/or subject to technological progress[25]

(iii) Estimate the economic value of environmental services and goods, both now and in the future (Appendix 1.2 provides a demonstration of economic valuation of natural resources taking into account future generations)

(iv) The economic value of natural capital remains constant in real prices over time

(v) Protect, as far as possible, non-substitutable natural capital

(vi) Avoid irreversible processes.

[25] Pearce and Turner (1990).

Appendix 1.1

Economic analysis of efficient provision of common pool goods

Let us assume the case of a hunting activity. Harvest is obtained by using some production factors, say labour.

Let us also assume that the cost of labour (marginal cost corresponding to the opportunity cost of labour in the economy) is constant and is worth 4 m.u.

Assume finally that the production function is of the following form:

$$Y = - l^2 + 8l$$

From the economic point of view, the efficient exploitation of animals is where the Marginal Value Product (MVP) of harvest equals the Marginal Cost (MC) of labour.

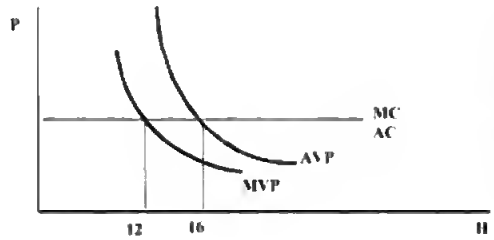
The MVP is obtained by calculating the first derivative of the production function, i.e.:

$$MVP = - 2l + 8$$

At this stage it is possible to calculate the efficient level of exploitation of animals. In the table below are reported the values of harvest (Y) and MVP given the MC of labour (MCl).

If l=	Y	MVP	MCl	AVP=Y/l except for the 1st
0	$(-0^2+8*0)=0$	(-2*0+8)=8	4	8
0.5	3.75	7	4	7.5
1	7	6	4	7
1.5	9.75	5	4	6.5
2	12	4	4	6
2.5	13.75	3	4	5.5
3	15	2	4	5
3.5	15.75	1	4	4.5
4	*16*	*0*	*4*	*4*
4.5	15.75	-1	4	3.5
5	15	-2	4	3
5.5	13.75	-3	4	2.5
6	12	-4	4	2
6.5	9.75	-5	4	1.5
7	7	-6	4	1

The above data are used to draw the graph below:



P: prices
MVP: marginal value product
AVP: average value product
MC: marginal cost
AC: average cost
H: harvest

The level of output that makes the MVP equal to the MC of labour is 12. This is also the point where hunters maximize their benefits or, which is the same, marginal benefits are just equal to marginal cost.

Let us assume now that resources are open access. In this case, there will be no restrictions to hunting. New hunters will be attracted by this activity as long as the Average Value Product (AVP), that is the total value of production divided by the total harvest, is higher or equal to the Average Cost (AC) of labour (also equal to the opportunity cost of labour in the economy). The values of AVP are reported in the table above and the corresponding curve is depicted in the graph by the curve AVP. It can be seen from the table and the graph that the new harvest level (16 units) is higher than the previous efficient situation, thus resulting in excess exploitation. It is also worth noting that marginal productivity is zero.

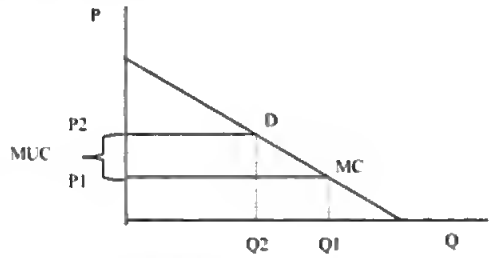
In an open access situation, the main reason why hunters will overexploit the resources stems from the fact that the benefits derived from restricting harvest to the efficient level by one hunter would not be captured by the same hunter but by other hunters.

Appendix 1.2

Pricing of natural resources taking account of future generations (Marginal User Cost Concept) [26]

Since resources are scarce, present uses of resources diminishes future opportunities. If large quantities of resources are used now, future generations will bear higher costs for exploiting the same resources. In other words, if the present uses of resources do not account for their *scarcity value*, scarcity in the future will increase, thus leading to extra costs to society to exploit the same resource. The cost of extracting a resource is measured by the *marginal cost (MC)* of extraction, i.e. the cost for extracting the last unit of resource. A rational user will exploit the resource up to the point where marginal cost is equal to *marginal benefit (MB)*. The understanding of this equality is straightforward. Indeed, if the cost of extracting one additional unit of resource is lower than the marginal benefit generated by that same unit, there is still room for the user to increase his net benefits. If by contrast, the marginal cost is higher than the marginal benefit, the user gets negative net benefits. The optimal quantity of resources to exploit is given by the point where MC=MB.

In a static efficient allocation model, the price of the resource would be equal to the MC. In a dynamic efficient allocation model, taking into account the time factor and future generations demand, the MC is not equivalent to the price of the resource. The price of the resource is the MC + the *marginal user cost* (MUC), or the additional marginal cost that future generations will bear if there is excess use now. By introducing the MUC in resource pricing, the optimal extraction level will be lower, thus leading to less exploitation and higher sustainability of resources. This is illustrated in the graph below where MC is a constant marginal cost, MUC is the marginal user cost, D is the demand for the resource, Q is the quantity extracted and P is the price per unit of resource.



It is clear form the graph that if the MUC is added to the MC of extraction, the total marginal cost (MC+MUC) increases from P1 to P2 and the quantity of resources extracted decreases from Q1 to Q2.

[26] For a more rigorous and formalized illustration of how MUC can be calculated, the reader is referred to Tietenberg (1996, pp 25-30).

CHAPTER 2

DECENTRALIZATION AND ENVIRONMENTAL ISSUES

2.1 SUMMARY

The purpose of this chapter is to analyse the **role** of **decentralization** in addressing environmental problems. It first proceeds with the **definition of decentralization** and examines the various forms it can take. It then reviews the **advantages and possible constraints** of decentralization in coping with environmental problems.

It concludes that **decentralized** decision-making is an **important condition** for addressing environmental problems properly, but it also points out that this is **not a sufficient reason** to assume that all related decisions should be taken at the decentralized level.

Examples are provided that demonstrate **when** and **how** environmental problems can be addressed directly by the affected people (**individuals**) without intervention of any kind of institution (this is the case of some environmental problems at the farm level) and when and how they can be solved either through negotiation between **private or civil organizations** (which do not involve public institutions) or through **government intervention**.

At the end of the chapter, a number of **criteria** are suggested for helping to choose the institutions more suited to solving the environmental problems.

2.2 DEFINITION AND CONCEPT OF DECENTRALIZATION

Decentralization as transfer of functions

Decentralization is a process through which authority and responsibility for some functions are transferred from the central government to local governments, communities and the private sector.

This process involves that decentralized institutions, either local offices of central government or local private and civil organizations (entrepreneurs, farmers, communities, associations, etc.) be provided with higher power in policy making and decision taking. The underlying tenet of decentralization is the *subsidiarity* principle.

Subsidiarity principle

Subsidiarity principle entails that decisions should be made by the populations affected or, on their behalf, by the authorities closest to them unless the origin of problems and/or their solution is out of control by the local communities.

2.3 FORMS OF DECENTRALIZATION

Decentralization may take various forms. The four main forms are reported below and shown graphically in Figure 2.1.

Political

Political decentralization is associated with increased power of citizens and their representatives in public decision-making. It generally involves a representative political system based on local electoral jurisdictions and pluralistic parties.

Administrative

Administrative decentralization is the transfer of responsibility for planning, financing, and managing certain public functions from the central government and its agencies to field units of government agencies, subordinate units or levels of government, semi-autonomous public authorities or corporations, or area-wide, regional, or functional authorities. In turn, administrative decentralization may take the following forms:

(i) *deconcentration*, which consists of redistribution of decision-making authority and financial and management responsibilities among different levels of the *central* government. This form is often considered the weakest form of decentralization;

(ii) *delegation*: through delegation central governments transfer responsibility for decision-making and administration of public functions to semi-autonomous organizations not wholly controlled by the central government, but ultimately accountable to it (e.g. sub-national housing authorities, transportation authorities, regional development corporations); and

(iii) *devolution*: in a devolved system, local governments have clear and legally recognized geographical boundaries over which they exercise authority and within which they perform public functions (e.g. raising revenues, investment decisions). It is this type of administrative decentralization that underlies most political decentralization.

Fiscal

Fiscal decentralization is associated with the authority of the decentralized units to make expenditure decisions with funds either raised locally (e.g. user charges, co-financing with users, property taxes, borrowing, etc.) or transferred from the central government. In many developing countries local governments or administrative units possess the legal authority to impose taxes, but often the tax base is not sufficient to undertake local investments, so that they rely heavily on government transfers.

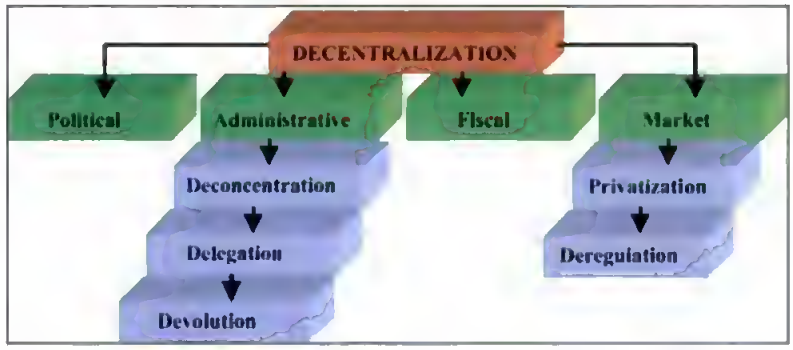
Market

Market decentralization is the most decentralized form in as much as decision-making power is transferred from public to private organizations. It can take two different forms:

(i) *privatization* which means allowing private enterprises to perform functions that had previously been monopolized by government, or contracting out the provision or management of public services or facilities to commercial enterprises, or still financing public sector programmes through the capital market and allowing private organizations to participate; and

(ii) *deregulation* which consists of transferring services provision or production activities previously owned or regulated by the public sector to competing private organizations (e.g. electricity or broadcasting provided by various and competing companies).

Figure 2.1 Forms of decentralization



Moreover, two major implications are incorporated in the above decentralization forms:

Geographical and institutional dimensions

Geographical decentralization, a shift from central/national decision-making to regional/local decision-making. This holds for the political, administrative, and fiscal forms;

Institutional decentralization, a shift from central government decision-making to local government and/or public and private organizations involvement. This holds for all the types of decentralization.

2.4 SOME GOOD REASONS FOR DECENTRALIZATION

The following reasons are usually put forward to justify decentralization of decision-making for addressing environmental problems:

When environment is addressed at decentralized level

- local institutions and people have a better knowledge of the environmental and socio-economic problems of the area and therefore are best placed to enhance and protect the environment if they are given clear rights (and obligations) with regard to natural resources[27];
- higher responsibility in decision making will be accompanied by higher motivation for a more efficient use of natural resources;
- it is more likely to involve less favoured groups and populations in the decision-making;
- facilitates local participation because of the higher homogeneity of common needs with lower sizes of population[28], higher transparency of the decision-making process; and
- allows the building of local capacities for the provision of services that are more consistent with the local requirements.

Environmental problems are location-specific

Geographical decentralization is particularly suited to the nature of environmental problems because they are often location-specific and can be dealt with comprehensively at various geographical levels. The design of institutional arrangements and policy instruments to take account of differences in environmental and ecological factors among geographical areas has been recognized in several studies[29].

A good example is coastal water pollution due to nitrogen fertilizers. The impact on coastal water pollution of *source-specific nitrogen fertilizers* depends on many factors such as soil quality and hydrology, which differ in various watersheds or drainage basins. In this case it might be more cost-effective to introduce area-specific regulations able to reflect better the differences in the contribution of various areas to coastal water pollution.

As far *as institutional decentralization* is concerned the forms of institutional arrangements best suited will depend on a number of factors[30], such as:

[27] FAO (1993).

[28] Oates (1972).

[29] See for example, Tietenberg (1979) and Siebert (1992), Ostrom (1993).

[30] All the factors described subsequently in the text contribute to the *transaction costs*. This concept is related to the degree of complexity to find a solution in presence of conflicting interests in the use of environmental resources. The higher the complexity, the larger the transaction costs. A more formal definition of transaction costs is given by North (1996) who states: *"Transaction costs are the most observable dimension of the institutional framework that underlies the constraints in exchange. They consist of those costs that go through the market, ..., and therefore are measurable, and of hard-to-measure costs that include time acquiring information, queuing, bribery, and so forth, as well as the losses due to imperfect monitoring and enforcement. These hard-to-measure costs make it difficult to assess precisely the total transaction costs resulting from a particular institution"*. Suggested further readings on these topics are: Williamson (1975, 1979, 1985); Stiglitz (1985), Nabli and Nugent (1989).

Factors impinging on institutional arrangements

- *type, scale and timeline*[31] of the environmental issue: this has to do with the nature of the good or service in question (type), the area and/or populations affected by it (scale), and the occurrence of the effects, either positive or negative (timeline);
- *number of parties*: this factor may increase the difficulty of parties to find a solution to the problem in question, and thus require the intervention of external institutions (courts, government);
- *conflicting interests among parties*: in this case, the achievement of an agreement between the parties may be constrained by the importance of conflicts; the higher the conflicts, the lower the probability that the parties involved will be able to come to an agreement without the intervention of an external institution;
- *property rights*: if property rights are non-existent or poorly defined, it is likely that co-operation between the parties in solving the conflict will be more complex;
- *asymmetries of information:* if information is incomplete, the party with more information will try to take advantage of it to maximize its benefits at the expense of the other party. It is also likely that the party with less information will try to minimize its loss by, for example, searching the information needed. Overall, these activities will increase the difficulty and resources (costs) required to solve the conflict;
- *distance* between the area where the environmental problem is *produced* and the place where it is *consumed,* and between the parties: the higher the distance between the source of the environmental problem and the peoples affected, the higher the probability that information will not be perfect and solutions to the problem difficult;
- *enforcement costs*: once conflicting parties come to an agreement for solving one environmental problem, they will establish some rules (i.e. define property rights) everybody must comply with. Enforcement of compliance is usually carried out by one neutral institution (e.g. court of justice, police, and so forth), which is able to measure the attributes of an agreement (contract) between the parties and to enforce an agreement in such a way that the offender finds costly to violate the contract. All this has a cost, which increases along with the complexity of agreements. These costs can be minimized by choosing or setting up able and reliable institutions;

[31] The timeline issue is based on the argument that individuals attach less weight to a benefit or cost received in the future than they do to a benefit or cost received now. Yet, given that many environmental investments (for example, forestry and soil conservation) produce benefits in the long term, alternative investments yielding benefits in the short term will generally be more attractive to individuals. However, short term benefits of individuals may be in contrast with long term benefits to the whole society. Government intervention in this case is justified to ensure that social goals are met. For more details on the time preference issue in economic analysis of the environment the readers are referred to Pearce and Warford (1993).

- *institutional setting* of the country: sometimes existing institutions are sufficient to cope with the problem in question. It may happen, however, that new institutions may better address specific environmental problems. It is worth mentioning here the recent creation in many developing countries of ministries of the environment or environmental agencies;

- *cost-effectiveness* of the intervention: this concept suggests that those institutions/organizations should be chosen which can provide the most effective intervention at the lowest cost; and

Provision of environmental goods and services entails:

- financing
- production
- regulation
- consumption

- *strengths and weaknesses* of public and private sector organizations in performing different types of functions related to the environmental issue. This concept is related to the provision of environmental goods and services. The underlying idea is that any good or service can be broken down into four components, namely financing, physical production, regulation of its provision, and consumption. Each single component can be addressed by diverse institutional levels or organizations. The analysis of strengths and weaknesses of the institutions/organizations involved will help to identify those which can assure one or more of the above mentioned components at the lowest cost.

Let us take for example the case of *nonpoint pollution*. This form of pollution is hardly manageable at the local level because it is originated by a high number of sources scattered all over a given geographic area (e.g. farms in the watershed), may involve a high number of parties and large distances between the place where the problem is produced (e.g. mountain area upstream) and the place it is consumed (e.g. the coastal area downstream). As a consequence, information may not be perfect, and transaction costs be very high. In this case, it may not be cost-effective for the local institutions to address and solve the problem. It is more likely that higher level institutions incorporating all the geographical area were pollution is originated and consumed (e.g. local government level) are better placed to cope with this sort of problem, either alone or in combination with local institutions. For these interventions to be effective, however, it should be made sure that all the factors mentioned above are taken in due account.

2.5 POSSIBLE CONSTRAINTS TO DECENTRALIZATION

Factors hindering decentraliz-ation

As pointed out in the previous section, decentralization is not a *panacea* to all environmental problems. On the contrary, in some circumstances decentralization may lead to higher inefficiencies. Some of these circumstances are reviewed below.

- ***Weak administrative*** or technical capacity at local levels may result in services being delivered less efficiently and effectively in some areas of the country;

- Administrative responsibilities may be transferred to local levels without adequate ***financial resources***, making equitable distribution or provision of services more difficult;
- Decentralization can sometimes make coordination of national policies more complex and may allow functions to be captured by ***local elites;***
- Also, ***distrust*** between public and private sectors may undermine cooperation at the local level;
- It must also be pointed out that decentralization may entail higher costs of ***enforcement*** of compliance with the regulations and, in some circumstances;
- It may lead to increasing ***conflicts*** among various areas sharing the same natural resources, and also between hierarchical levels if coordination is not effective;
- Sometimes, local organizations lack the necessary ***scientific knowledge*** to complement their indigenous experience and knowledge; and
- Finally, decentralization may have ***initial high costs***, which, in a first stage, can increase government spending.

The above factors highlight the limits of the view that local governance is better than higher level governance. The lesson that can be drawn from the previous sections is that the identification of the most appropriate institutional setting to tackle the environmental problems requires a careful analysis of all the factors described as well as of the features of the environmental issues.

Some environmental and natural resources' management problems can be addressed and solved at the farm level by individuals or private organizations. Others can only be solved at national/sub-national and international level by governments. Most frequently, the way to overcome the complexities of ecological and environmental processes is to develop institutional arrangements at multiple levels able to cope with the specificity of the environmental issues and to provide the correct incentives to the users at each level of the hierarchy. The following sections provide an illustration of various cases of environmental goods and services requiring different institutional involvement.

2.6 RESOLUTION OF ENVIRONMENTAL PROBLEMS AT THE FARM/HOUSEHOLD LEVEL

Environmental problems

Environmental problems faced by farmers can be generated:

- *outside* the farm; in this case they assume the characteristic of negative externalities for the farmers;
- *inside* the farm; in some cases the farmer can address and solve these problems directly at the farm level with no intervention of higher level institutions.

... outside the farm

A classical example of problems generated **outside** the **farm** or negative environmental externalities at the farm level is given by soil degradation due to wind or water erosion. If the degree of land degradation is not too high, common agricultural practices can be used by farmers to restore the productivity of the soil. These practices can range from increase of inputs and fertilizers (which, however, can have adverse effects on soil acidification) to crop rotation, minimum tillage, proper management of fallow periods[32].

... within the farm

Environmental problems originating **inside** the **farm** and leading to land degradation are soil compaction, salinization, acidification, waterlogging. Also in this case, decisions to address and solve the problems can be taken within the farm with no need of intervention from government at either local or national level, provided that the farmers can afford to pay the costs required and perceive it is in their interest to do so. In other words, they will decide to improve their conservation practices if they can find financial resources and they expect their returns to increase.

... beyond the farm household

If, however, land degradation or air pollution problems are severe, restoring land or avoiding health effects of air pollution may require more resources than usually available at the farm/household level. For example, land restoration may require extensive engineering works, watershed management, irrigation and drainage system, etc., all of which cannot be undertaken by individual farmers. Air pollution abatement can only be achieved through policies aimed at reducing carbon dioxide emissions from industries or vehicles. In such cases government intervention may be required either at the local or at the national level.

... at national/ subnational level-

In addition, if the cause of land degradation is due to policy failures such as subsidies on irrigation water that are responsible for inefficient use of water at the farm level, and in turn for salinization problems, government intervention at the national or subnational level can be required to overcome the problem. In this case, farming practices are strictly dependent on policies. It is therefore a policy problem to introduce an incentive system sufficiently profitable to induce farmers to adopt more sustainable practices.

2.7 RESOLUTION OF EXTERNALITIES THROUGH NEGOTIATIONS AMONG PARTIES

Externalities imply that at least two parties are involved: the "*producer*" of the externality and the "*consumer*". It is very frequent that negative environmental externalities are solved directly by the affected parties before the problem reaches the public forum.

Let us assume, for example, the case of water. Water resources provide a number of goods and services that are valuable to economic activities. Among

[32] Other possible farming practices include, intercropping, crop rotations, retained crop residues, enhanced shelterbelts, water management, integrated pest control, sylvo-pasture, green manuring with legumes, etc. (Conway, 1987).

Resolution of externalities

the goods are irrigation water, industrial water, domestic water, recreation and tourism water. Among the services are habitat protection, biodiversity, waste absorption, and so forth. In many developing countries water goods and services are often free of charge, which means that their scarcity value is equal to zero. As a result, individuals using water for irrigation, industry, waste discharge, tourism and recreation, tend to use larger amounts of water than economically feasible.

Let us consider the case of wastes' absorption services of water resources. Farmers use water courses (rivers, streams, lakes, etc.) to discharge the waste waters of their activities (livestock, agriculture). Most of the time they are not charged for this service. Therefore, it is likely that there will be excessive run-off of fertilizers and pesticides in water courses, resulting in increased pollution of water and in negative externalities to other users. Since water quality is not priced and cannot be marketed (market failure) the market place is not the appropriate institution to solve the problem of pollution. It is more likely that the appropriate solution will be found either through negotiations among the stakeholders or through the public intervention at various levels (regulations, courts, and/or economic incentives).

... through negotiation-

With negotiation, for example, the perpetrators of the environmental impact will be willing to accept an amount of money to compensate for the foregone benefits they would incur if they reduced water pollution, whereas, the people suffering from the bad externality will be willing to pay an amount of money to continue to use the recreational services of water resources. The parties will agree on the amount of money that will maximize the benefits of both the perpetrators and the suffering population. In other words, the social optimal use of environmental resources will be achieved. This is known in the literature as the *Coase Theorem*[33] and is demonstrated with an example in Box 2.1.

... through local government-

In the situation described in Box 2.1, government intervention is not necessary unless negotiations do not lead to a solution of the conflicting interests (for example, because of high transaction costs). Moreover, if government is necessary and the scale of the problem and the parties affected are confined at the sub-national level (say local government), it is also likely that the most suitable institutions to decide upon the measures to be undertaken are the government institutions at the local government level.

[33] Ronald Coase (1960).

Box 2.1 A demonstration of the Coase Theorem

Suppose a large farm is polluting a lake, and the water of the lake is used for consumption and for recreation by the community living around the lake. Suppose that the benefit for the large farm to discharge its pollution in the lake is US$1 000 (for example, this may mean that it would cost US$1 000 for the plant to stop discharging in the lake by reducing its pollution or by discharging in some other location). Suppose that the benefit for the community of using the lake is US$1 200 (for example, this may mean that if the community had to stop using the water of the lake, it would have to pay US$1 200 to obtain water from some other sources). Given these values, the social optimum in this case requires that the lake be used by the community for consumption and recreation purposes since it is in this use that the lake creates the largest value.

Indeed, since it would cost US$1 000 for the plant to stop using the lake to discharge its pollution, the large farm would accept any compensation above US$1 000 to stop discharging in the lake. On the other hand, it costs US$1 200 for the community not to use the water of the lake. The community would be willing to pay up to US$1 200 to be able to use the water from the lake and still be better off. Since the community is willing to pay more than what the large farm would require to stop its discharges, there is room for negotiation. Negotiation will result in the community compensating the polluters to induce them to stop polluting the lake. The lake will therefore be used for consumption and recreation by the community.

As a result, the common good (i.e. water) has lost its property of non-excludability and becomes a marketable good with well defined property or user rights.

2.8 RESOLUTION OF ENVIRONMENTAL EXTERNALITIES WITH SPILLOVER EFFECTS OUTSIDE THE AREA

The situation will change significantly if property rights cannot be defined and the environmental problem is generated in one area but has spillover effects into neighbouring areas or into the whole country and maybe the whole world. In this case, as pointed out by Smith (FAO, 2001) Pareto-efficiency criterion "... *implies that the services should be controlled and financed at that scale where there are no spillover effects*". Spillover effects also entail that a higher number of parties with conflicting interests are involved and, consequently, that a direct negotiation between the parties is more difficult.

Government intervention when direct negotiation among parties is difficult

An example of this situation is tropical deforestation. The environmental concerns raised by deforestation are manyfold, the most important of which are: a) global climate change; b) loss of biodiversity; and c) extinction of indigenous populations. The fundamental function of tropical forests in climate regulation, biodiversity conservation, and life assurance to indigenous peoples are considered today as major international goals. It follows that even though some agreements could be achieved between the parties directly involved in deforestation at the country level, that solution could be deemed immoral from the societal standpoint if it does not account for all the above mentioned functions, and for the opinion of the international community.

Government intervention either at national level or international level is justified in this situation on the ground of moral and equity arguments, which usually involve the whole society (in this case the whole world community) and cannot be addressed only at the sub-national level by governmental or private institutions.

2.9 SOME RULES FOR CHOOSING THE MOST SUITABLE INSTITUTION/ORGANIZATION TO COPE WITH ENVIRONMENTAL PROBLEMS

In the previous sections it has been made clear that the appropriate level for addressing environmental problems is more an empirical question than a well defined procedure. Broadly speaking, the following rules can be devised for considering the most appropriate institutions or organization for addressing the environmental problems. A summary of these rules is provided in Table 2.1.

Central government

Government institutions at the central level can be considered if:

(i) number of parties involved and conflicting interests are high;

(ii) geographical distance between the parties is large;

(iii) transaction costs are high;

(iv) negotiations between the parties cannot achieve important social, political, and moral goals;

(v) property rights are not defined clearly;

(vi) the scale and timeline of environmental problems cannot be addressed by individuals or private organizations;

(vii) the measures deemed to be the most appropriate for addressing the problem can only be undertaken by the central government. This may be the case of macroeconomic policies (exchange rate, import and export taxes/quotas, etc.); and

(viii) lack of skilled personnel at the decentralized level.

Sub-national government

Sub-national level government institutions are better suited than central level if (i) to (iv) of the previous point occur and when the scope and scale of environmental problems can be managed properly and cost-effectively at the sub-national level. It is also important that the measures necessary to solve the problem can be decided and implemented at the sub-national level. For example, sub-national government institutions could be involved effectively in watershed management, installation of catchment basins, and other soil-conservation measures that are typically adopted at the sub-regional level. For this to be feasible and effective, however, a political, administrative, and fiscal decentralization should already exist in the country.

Table 2.1 Criteria and suitable institutions to address environmental issues

Criteria	Institutions		
	National government or higher level*	Government at lower level	Parties and other public or private organizations**
Scale of the problem			
• Global	*		
• National	*		
• Local government	*	*	
• Community		*	*
Type of measures			
• Measures that can only be decided at national or higher level (e.g. exchange rates, population planning policies, etc.)	*		
• Measures that can be implemented at the lower levels (e.g. water charges, some norms and standards, etc.)		*	
• Measures that can be implemented by the private sector and individuals (e.g. agricultural practices, etc.)			*
Conflicting interests			
• High	*	*	
• Low			*
Geographical distance			
• High	*	*	
• Low			*
Transaction costs* **			
• High	*	*	
• Low			*
Property rights			
• Public good	*	*	
• Non Public good	*	*	*
Information and awareness			
• Uncertain	*	*	
• Perfect	*	*	*
Enforcement costs			
• High	*	*	
• Low	*	*	*
Institutional system			
• Decentralized		*	*
• Not decentralized	*		

* Institutions that can be involved individually or in combination with lower level institutions.

** Community organizations, farmers' associations, NGOs. Parties may also include government institutions.

*** It is worth noting that transaction costs are to a certain extent dependent on other criteria such as geugraphical distanec, information and awareness, number of parties, conflicting interests.

Civil society organizations

Private or civil society organizations (entrepreneurs, farmers' associations, NGOs) are better suited when:

(i) only few parties are involved;

(ii) negotiation costs are low;

(iii) the "producer" of the externality is aware of and informed about the effects;

(iv) the cause and the effects of the externality take place in the same geographical area (local government, community, etc.) or very near the source; and

(v) property rights are defined or can be easily defined.

2.10 BASIC CONDITIONS FOR SUCCESSFUL DECENTRALIZATION

In order for decentralization to be effective and sustainable, a number of conditions must be respected. Among the most important are the following:

- sufficient **financial resources** to ensure the accomplishment of the tasks under the responsibility of the local and decentralized institutions;
- actual **empowerment** of decentralized institutions and enough power to influence the political system and the development activities;
- **accountability mechanisms** such as local elections to improve transparency and representation;
- **legal framework** clearly specifying the powers and responsibilities of local governments to avoid interference and overlapping with central government; and
- adequate **capacities** of local institutions to ensure the appropriate services.

Following the forms of decentralization of Figure 2.1, the above conditions can be summarized into three main points including the **political, administrative, and fiscal dimensions**. So, for example,

- if decentralization is not accompanied by a real **political will** at the central level and **actual transfer** of legislative and policy powers (political dimension);
- if local institutions are not provided with the **responsibility of delivering and managing** services at the local level (administrative dimension);
- if mechanisms, authority, and **responsibility for spending funds** obtained either from direct taxation or from central government are not clearly defined (fiscal dimension) then most probably decentralization will not generate the advantages pointed out in Section 2.4.

CHAPTER 3

FOSTERING ENVIRONMENT IN DECENTRALIZED DECISION-MAKING

3.1 SUMMARY

Fostering the environment in decision-making for sustainable development involves a number of changes that range from technical, political, institutional, and cultural.

The role of the government, both at the central and local level, is of utmost importance to set up the appropriate environment for these changes to occur.

The instruments available to the government are **direct investments,** the **incentive system**, and the **institutional system**. For these instruments to be properly used in the environmental sector at the decentralized level, two conditions are necessary:
real and not formal **empowerment** at local government level; and
participation of people in the decision-making process.

Environmental consideration in decision-making for sustainable development at the local government level also requires that an appropriate **decision-making framework** be designed, able to account for all dimensions of sustainable development, including environmental, economic and social.

3.2 THE ROLE OF GOVERNMENT

Creating an enabling context

As pointed out in the previous chapter, the intervention of the government both central and local in addressing the environmental problems is indispensable in some circumstances. The government plays an important role in the creation of the overall context within which the private parties operate and make decisions related to the environment.

Three broad and interrelated means are available to set up a sound and effective context for integrating the environment in decision-making:

- direct investments;
- regulatory and market based instruments; and
- the institutional set-up.

In addition to influencing the behaviour of individuals towards the use of the environment, the above means include powerful instruments for:

- *capacity-building* within and outside of the government;
- *awareness* creation both within the government and among communities;
- *communication* between the government and the communities (vertical communication) as well as between communities (horizontal communication); and
- *participation* of local communities in the decision-making process.

In Nigeria, for example, a proposal has been submitted to the Federal Ministry of Education which recommends, among others things, to initiate a national environmental awareness campaign and establish a Conservation Club Programme at the community level that will distribute environmental related material and will mediate with foreign environmental donors for specific project funding and technical support[34].

3.2.1 Direct investments

Despite the fact that it is largely accepted now that the major role of the public sector is not so much to undertake economic activities aimed at the production of goods and services to be sold in the market, but rather to provide the private sector with the necessary services and incentives to ensure that resources invested are allocated in those activities generating the highest returns to the society, there are some circumstances, which do justify a direct involvement of the public sector in investment projects and programmes. Among the most important the following can be mentioned:

Cases for public sector investment

- investments are not profitable from the financial (private) point of view but they generate positive returns from the economic (society) point of view;
- investments involve public goods and externalities;

[34] Reported by Lampietti & Others (1995).

- financial benefits of the investment occur in the long-term whereas costs are borne in the short-term: and
- investments are subject to high risks as to the financing of the project. This aspect is very much related to the life span of the project.

All of the above circumstances are typical of the environmental sector. Indeed, conservation and protection projects are generally characterized by very long benefit generating periods, high positive externalities for which the generators are not paid, limited financial benefits for the entrepreneur, and high risks regarding the financing of the project.

... in view of economic social and environmental objectives

The private sector will most likely not be attracted by such investments because they will certainly find alternative investments generating higher financial returns with less risks. This is not the case of the public sector, whose objectives are broader than just maximizing private profits. In addition to economic objectives (e.g. maximizing the welfare of the whole society), the public sector aims at achieving social objectives (e.g. distribution of income), and environmental objectives (e.g. habitat conservation, wildlife protection, etc.) which are generally not accounted for by private investors.

Decision criterion

Let us consider, for example, a reforestation project. The private sector will only be interested in financial returns; that is, the returns generated by selling the goods and services produced with the investment. It will not be interested in other benefits which do not generate a flow of money. Yet, we know that apart from producing timber and other marketable goods, reforestation generates a number of other services that are not exchanged in the market (i.e. erosion control, water and air quality improvement, and so forth). The decision criterion of the private entrepreneur as to whether to invest in reforestation or alternative projects will rely on the comparison between the financial net benefits of

... of private entrepreneurs

reforestation (i.e. the money earned with the selling of timber and other goods) and the financial net benefits of the alternative project. She/he will choose to invest in reforestation only if the Financial Net Present Value (FNPV) of reforestation (i.e. the sum of the discounted flow of financial net benefits) is higher than the FNPV of the alternative project. The evidence shows that this situation is not common because positive discount rates tend to minimize the costs and benefits occurring in the future as compared to the costs and benefits

and

occurring in the short-term. In addition, investments in long-term projects such as reforestation are subject to higher financing risks. It follows, therefore, that private entrepreneurs will be more attracted by alternative investment projects.

... of the public sector

The public sector will use a different decision criterion. Since its objective is not to maximize private profits but rather to maximize the welfare of the whole society, it will also consider the benefits accruing from all non financial services provided by the forests. Indeed, it will take into account the positive impacts of forests on air quality, on water quality, on soil protection because the whole society will be better off if these services are provided. If these values are added to the value of the goods sold, the final profitability (generally named economic profitability) of reforestation may become higher than alternative projects.

It is worth noting that **private sector can be involved in environmental related investments if appropriate policies are set up**, which promote incentives for this kind of investments. These issues are discussed in more detail in the following sections.

3.2.2 Regulatory and market based instruments

Incentives for environment related investments

The incentive system consists of a number of **regulatory** and **market based** instruments aimed at modifying the behaviour of individuals towards the consumption of environmental goods and services.

Regulatory instruments are, for example, pollution emission standards, issuing of licenses and permits, land use controls, definition of property rights, and so forth.

Market based instruments include taxes, user charges, emission charges, subsidies, deposit refunds and tradeable permits (see Annex 1 for a brief illustration of the main instruments).

the widespread use of regulatory instruments

It is worth noting here that, thus far, **regulatory instruments are the most frequently recommended both in industrialized countries and in developing countries for addressing environmental problems**, though market based instruments are generally considered more cost-effective.

... and their implementation problems

Though an increasing number of countries are introducing environmental measures, **their application is still faced with a number of problems**, mainly due to the poor institutional capacity of developing countries. Regarding the regulatory instruments, it has been observed that the major problems are:

- the vagueness in the specification of the type and quality of standards and ambient concentration of pollutants, which sometimes is responsible of unreasonable high standards and low compliance; and
- the difficulty and poor capacity of countries to set, monitor, enforce, and administer the regulations.

Market based instruments (taxes, charges, subsidies, etc.) are seldom applied in the developing countries due to:

- unfamiliarity with these means;
- lack of expertise to assess the impact of these measures.

3.2.3 The institutional set-up

Mainstreaming environment in decision-making through:

The institutional system is the organizational arrangement and functioning of all the bodies – public and private – involved in environmental management and analysis. The role the institutional set-up plays in mainstreaming the environment in the decision-making process is particularly important because it:

...legislation
- determines the effectiveness and quality of the environmental legislative framework;

...information
- ensures awareness, information and communication creation on the major environmental issues (e.g. information dissemination about the pollution records of large polluters facilitates negotiation between polluters and affected parties);
- allows access to environmental information at all levels, from farmers to decision-makers and from local communities to central government;

...enforcement and monitoring
- secures important services such as enforcement and monitoring;

... participation
- may encourage participation of communities; and

... property rights
- defines clear property rights.

The institutional set-up of many developing countries, however, is not adequate to provide the above services effectively for a number of problems, generally attributable to:

Commonly encountered institutional failures
- inadequate skills of the personnel;
- not clearly defined institutional responsibilities concerning the environment which often leads to duplication or poor coverage of some environmental issues;
- competition among agencies with environmental responsibilities;
- lack of co-ordination among the agencies;
- scarce financial resources; and
- limited involvement of private agencies in the provision of environmental services.

In addition to the above problems, the institutional system suffers from the vertical, hierarchical, and centralized structure of organizations of many developing countries. Indeed, local agencies at the local government or lower level generally lack the required institutional autonomy and resources to ensure a more efficient provision of the above services.

Government role

To overcome the above mentioned constraints, the government may play a major role in **promoting** and **supporting** institutional reforms aimed at creating a consistent and effective framework of organizations and rules able to ensure sustainable development, as well as **guaranteeing** the proper functioning of the institutional set-up. In particular, it may play a major role in achieving the following basic conditions for decentralized sustainable development.

Decentralization and empowerment

As pointed out in Chapter 2, decentralization is a necessary but not sufficient condition to cope with environmental and sustainability concerns at the local government level. Indeed, decentralization of some environmental services such as enforcement and monitoring is unlikely to produce any significant change towards sustainable development at the local government level unless it goes along with actual empowerment in decision-making. That is, unless the

principle of subsidiarity is respected. In practice, the higher the power of decentralized institutions, the wider the range of environmental related decisions that can be made by the local government administrations.

It is also important that decisions made at the local government level about the identification of priorities, the allocation of resources, and the related policies, be consistent and co-ordinated with decisions made at the other institutional levels, be they lower or higher levels. This would avoid situations in which management decisions made at certain levels offset management decisions made at other levels.

Decision-making must be thought of as a shared process in which the various institutional levels in the hierarchy interact continuously and undertake efforts for sustainability in a coherent fashion and within the same vision.

Cooperation and collaboration are also essential between the various agencies responsible for various aspects of natural resources management at the local government level. Given that environmental problems may involve more than one administrative area, collaboration is also necessary among local administrative areas. For example, in:

- using the same zonal classification system;
- sharing knowledge and information;
- developing joint programmes, policies, and legislation; and
- creating alliances to negotiate and influence decisions made at the central level.

Involvement and participation of the private sector

Effective decentralization in environmentally sustainable decision-making also includes a major involvement and participation of the private sector (NGOs, etc.) in the decision-making process and in the provision of environmental services when it is expected that they are more cost-effective. Indeed, given the scale and complexity of global-local relationships of environmental issues and the trade-offs between economic, social, and ecological objectives involved in sustainable development, no single organization, no matter how interdisciplinary it may be, can reflect the needs, the preferences, the diversity of interests that environmental problems can create, and manage alone the use of natural resources.

Moreover, the potential conflicting nature of economic, social, and environmental objectives often leads the decision-makers to make a choice among them. This choice cannot always be done on the basis of scientific criteria.

Often it is necessary to rely on the preferences and value judgements expressed by people on trade-off between economic, social, and environmental objectives. Conflicts also exist between individual interests and collective ones (see Box 3.1).

Box 3.1 Individual versus collective interests

Environmental problems are typically collective concerns whereas their causes are often based on individual actions. Indeed, each individual translates his/her needs and wants into preferences and consumption patterns, the sum of which determines the collective environmental problems (Dovers and Handmer, 1993).

One major challenge in decision-making for effective natural resource management within the framework of sustainable development is to balance the rights of the individuals to use natural resources with the rights of societies to have access both now and in the future to a healthy environment.

It is generally accepted that individual freedom to use natural resources is increasingly impaired by the decreasing capacity of the ecosystem to accommodate needs and that the quality of the environment is declining due to the excessive use of natural resources by individuals. The question is, therefore, how to address the conflicting interests of individuals and societies without affecting the freedom of choice of individuals.

One suggested possibility to cope with the problem is to explore ways of managing human activities through participatory programmes that simultaneously account for individual rights. This entails that individuals understand and are aware of their contribution to the collective concerns both at the local and global level.

The role of local governments and/or public and private organizations at the local government level would be to sensitize individuals in the tight relationships existing between their actions and the collective environmental concerns, to assist them in the effort to understand their contribution to the collective concern.

Examples of how private organizations could be involved effectively in contributing to decision-making and providing environmental services are the cases of Philippines and Madagascar. In the Philippines, the government recommends in its reforestation policy to use the private sector to execute government-funded reforestation projects. In Madagascar, the government intends to leave the management and the implementation of local development activities to NGOs because these organizations are more decentralized and thus have more access to remote areas and information, and can play a major role in communication with local populations.

Various **means** available to the government exist to achieve the above conditions. Some of them, such as research and extension, health, nutrition, financial institutions can be better thought of as part of nation-wide programmes[35]. Others such as participation and training can also be handled easily at the decentralized level.

[35] Well designed research and extension programmes and institutions can improve the circulation of information on technology, techniques, and markets, and lead to more efficient use of scarce resources. Health and nutrition programmes and institutions contribute to the improvement of human capital. Healthy and well nourished people are more productive and can absorb cognitive skills and investments in education more readily (Schuh and Archibald, 1994). Financial institutions can improve the circulation of financial capitals between private individuals and entrepreneurs and achieve a better allocation of capitals between alternative and competitive uses.

Stakeholder participation

Participation is a useful approach for facilitating negotiation, communication, information, awareness, and conflict resolution. Stakeholder participation together with co-operation among involved institutions in decision-making process allows to:

- cope with environmental issues in a more comprehensive manner;
- account for people's expectations;
- consider stakeholders' information on knowledge, capacities and technologies available in the area;
- facilitate exchange of information;
- identify with more accuracy discrepancies and define appropriate corrections;
- introduce new techniques and technologies more compatible with the environment;
- improve awareness and understanding of global/local environmental issues; and
- increase the chances of understanding and acceptance of actions and plans.

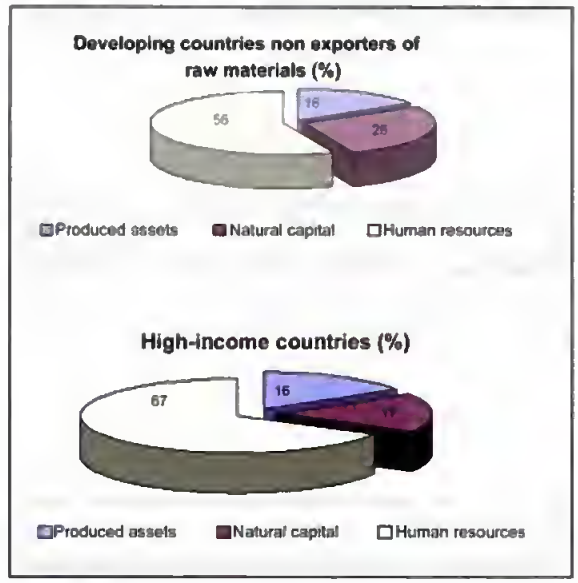
External assessment

To complement the participatory approach in environmental assessment it is sometimes worth relying also on independent (from stakeholders) assessment. External expert knowledge can give stakeholders new insights and avoid or overcome conflicts of interest generally emerging in self-assessment. External expertise can be provided either by public or private institutions, such as universities, NGOs, private research institutes, and so forth.

Increasing human capital lowers dependence on natural capital

Like health and nutrition, **training and education contribute to increasing the quality of human capital**. The evidence shows that the higher the human capital of a country is, the lower its dependence on natural capital (Figure 3.1 on the following page). Knowledge and skills improve the capacity of countries to develop and transfer new technologies, to sustain productivity growth, and to endow countries with well-trained staff at all levels (banks, universities, ministries, extension institutions and so forth). They also allow the exchange of information and better communication among institutions.

Figure 3.1 Capital endowment by income groups



3.3 A FRAMEWORK FOR ENVIRONMENTAL CONSIDERATIONS IN DECENTRALIZED DECISION-MAKING

Decision-making

Decision-making is "a continuing process of management and mediation among, social, economic, and biophysical needs which result in positive socio-economic change that does not undermine the ecological and social systems upon which communities and societies are dependent. Its successful implementation requires integrated policy, planning and social learning processes; its political viability depends on the full support of the people it affects through their governments, social institutions and private activities linked together in participative action". (Carley and Christie, 1992, as reported in FAO, 1994).

"*Decision-making* is the outcome of creative, fertile minds of people involved in the day-to-day delivery of services, products, and experiences, and is based on a mixture of hard (e.g. quantitative data) and soft information (e.g. observation and intuition)". (Mintzberg, 1994).

In the past, decision-making was often understood as a sequential and rigid model as the one illustrated in Figure 3.2. This process suggests that the various components and steps be addressed in a chronological sequence and that once one component has been analysed, there is no need to come back to it. This conventional approach was mainly aimed at **maximizing one objective**, usually the growth rate of the Gross Domestic Product (GDP), with poor integration of other goals (e.g. environmental, social, cultural, etc.). It was mainly **top-down**, that is government planning institutions identified problems and issues, set priorities, developed solutions and measures to be adopted by the people. This approach paid limited attention to some important aspects such as communication, capacity-building and participation.

Figure 3.2 Sequential framework of decision-making

Sequential model

The evidence shows that the above approach is in contrast with the sustainability concept. In the case of priority setting, for example, priorities at the national level do not necessarily correspond to priorities at the local level. Indeed, the behaviour of environmental systems changes significantly depending on, among other things, the geographical areas. So, non perceived environmental problems at the farm or local government level (e.g. wind erosion) may cumulate and become a major problem at the national level. Conversely, wind erosion may be the priority concern at the sub-national level but a minor one at the national level. In addition, the generating processes of these problems may also vary according to agro-ecological zones. For example, the causes of wind erosion in lowlands sub-arid areas will differ from the causes of the same environmental problem in mountainous areas.

As the quotations point out, decision-making for sustainable development is rather a process which:

Sustainable development model

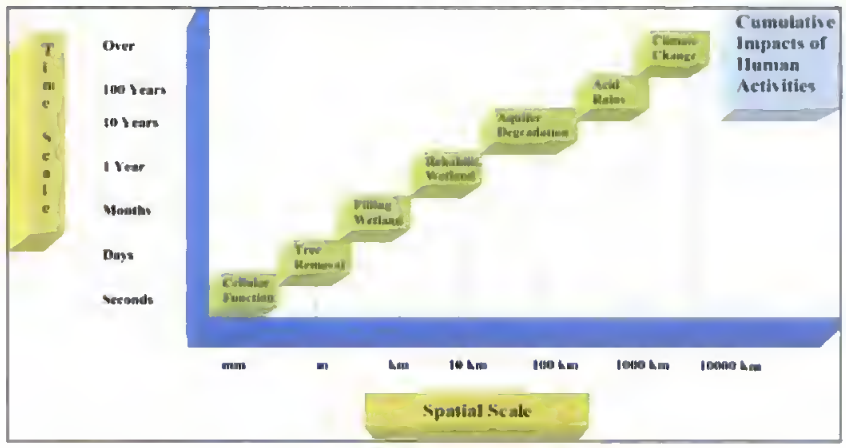
as a process

- is able to be **adaptive** to the evolution of the situations and to the diverse location-specific circumstances, since individual preferences, social norms, ecological conditions change over time and according to the locations;
- combines economic, social and environmental concerns, in a **comprehensive** and integrated fashion;
- takes due account of the **dynamic** interactions of these dimensions and of their dependence on the scale of the system. That is to say that the goals pursued at the sub-national level can have a different weight than the same pursued at national or higher levels;
- is **receptive** of time dimensions of humans and environmental processes. Indeed, human time spectrum and environmental processes are not synchronized. For example, most governments' decisions are short-term (from 1 year to 4-5 years) whereas environmental processes operate on a spectrum of time that can range from very short periods (seconds) to very long periods (decades, century). An illustration of the time-space

relationships of environmental processes and human activities is provided in Figure 3.3; and

- is based on **communication. participation**, and **capacity-building.**

Figure 3.3 Time and space dimensions of environmental processes



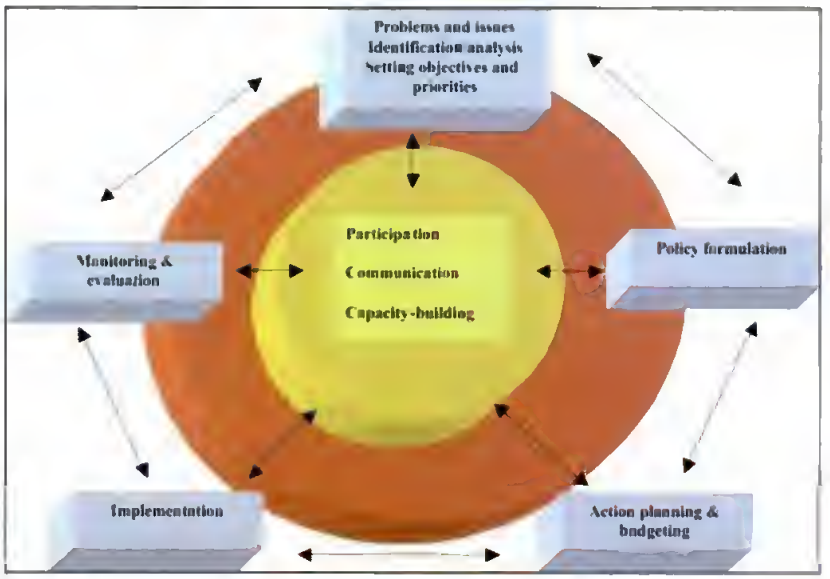
... of a cyclical and interactive nature

A more suitable framework able to incorporate the above mentioned aspects reflects more a cyclical and interactive process where the steps only indicate a logical sequence rather than a chronological one. For example, some components of decision-making such as information collection, monitoring, communication, capacity-building are activities that may be needed at any point of the process. Furthermore, some elements of them can be undertaken simultaneously. For example, implementation can take place at the same time as policy formulation or action planning. Moreover, with this approach, the goals are achieved progressively, through a continuous adjustment of the various components to the changing circumstances and the feedbacks between the components.

Figure 3.4 depicts one cycle of the framework described above and illustrates the possible feedbacks between the various components. This approach can apply to decision-making at the project, programme, plan, or strategy level.

According to the goals pursued, the time necessary for completing the whole cycle may vary significantly from less than one year if objectives are achievable in the short term (e.g. introduction of sustainable agricultural practices at the farm level) to several years or even decades if longer term goals are pursued (e.g. rehabilitation of habitats, etc.).

Figure 3.4 Framework for a dynamic environmentally sustainable decision-making



CHAPTER 4

ENTRY POINTS OF ENVIRONMENT IN DECISION-MAKING AT LOCAL GOVERNMENT LEVEL

4.1 SUMMARY

In principle, the entry point of environmental issues in the decision-making process may correspond to anyone of the steps illustrated in the framework in Section 3.3. The following sections will focus only on those activities of the decision-making process requiring particular attention to environmental aspects. These are:

- **natural resources assessment**: it consists of the diagnostic of the environmental situation of the area and the identification of environmental problems and potentials;
- **analysis of problems and objective setting**: it refers to the classification, ranking and prioritization of problems and opportunities, or broadly speaking, to the establishment of a policy framework which includes the principles, goals and objectives to be achieved;
- **action plan design and environmental policy measures**: it defines the environmental actions and policy measures at the local level aimed at achieving the priorities set out in the previous activity; and
- **monitoring and evaluation of ecosystems structure and functions**, including the relationships between human activities and environmental resources.

4.2 NATURAL RESOURCES ASSESSMENT

Multi-disciplinary analysis

Before proceeding with this point, it is worth recalling that the assessment of natural resources should not be thought of as a separate activity from other baseline studies such as social, institutional, sector analyses. On the contrary, it is a multidisciplinary activity aimed at analysing the interrelationships between economic, social, institutional, and environmental components of sustainable development. The outcomes of these analyses will provide a mechanism for monitoring and evaluating the actions carried out in the area.

This activity is aimed at gathering the information necessary to evaluate the natural resources both quantitatively and qualitatively and to identify, select, and prioritize the environmental **problems**. It is based on a series of analyses, which will help understand the nature of environmental problems and define the major environmental objectives. Information gathering may be based on field work and on secondary data that are already available from published sources or from project activities. It can be done by experts alone (e.g. local government officers) or in collaboration with stakeholders either within the government or external to the government. A list of the topics generally addressed in this activity is provided in Box 4.1. A practical demonstration of how such an assessment can be carried out within the purview of rural development planning at area level in China (county) is given in Annex 4.

Box 4.1 Data and information required for natural resources assessment

- geographic, demographic, socio-economic and cultural aspects of the area;
- environmental conditions and trends (quality and quantity indicators of natural resources and ecosystems -water, air, land, flora, fauna);
- importance and relevance of the resources base;
- causes of environmental problems (direct, indirect);
- ranking and prioritization of environmental problems;
- resources management practices; and
- inventory and examination of plans/programmes/projects with potentially important impacts on the environment as well as with strategies and plans at higher levels (national, sub-regional, international).

Two major issues deserve particular attention at this stage of the process: *defining the spatial context of decision-making and information gathering.*

4.2.1 Spatial contexts

The spatial context is intended as the geographical area in which information and knowledge is gathered about the social, economic, and environmental processes. Spatial contexts can be defined in various ways.

Administrative units

The most common and widespread classification of spatial contexts is based on **administrative units** (e.g. nation, province, district, sub-district).

In addition to the administrative units, there are spatial contexts based on **socio-economic** criteria, such as:

Socio-economic units

- *localities* or areas characterized by economic and social boundaries. "The defining characteristic of "local" is that there are face-to-face relationships and some sense of mutual identification and mutual interest among the people within that domain so that there is some potential for collective action and self-help. Up through the locality level (a grouping of communities that have some social and economic connections), many people know each other and feel that they have some common bond. There can be conflicts, but there is also some loyalty to people within one's group, community or locality, some willingness to cooperate. Above this, one is dealing with administrative rather than social units, where interpersonal relations are attenuated and dispositions for voluntary cooperation are diminished. Pecuniary interests pursued through market relationships and behaviour that is regulated, compelled or exhorted through state action are more important principles at the local government level and above. Face-to-face interaction is impractical if not impossible at higher levels of social aggregation"[36].
- *community* often synonymous of village, is a sub-level of locality. A set of communities that have economic and social ties form a locality;
- *group* is made up by persons within a higher level spatial context sharing some common interests;
- *household:* group of persons having direct relationship ties;
- *individual*.

Environment-based units

Finally, **environmental issue-specific** classification systems are generally available which integrate the information on the environmental resource base of countries, such as classification systems related to watersheds, land, forests, climate, agro-ecological zones, and so forth (Box 4.2).

Box 4.2 Some FAO definitions of Zones[37]

Agro-ecological zoning (AEZ)
The division of an area of land into smaller units, which have similar characteristics related to *land suitability*, potential production and *environmental impact* .

Agro-ecological cell (AEC)
An area or point with a unique combination of land, soil and climate characteristics. The agro-ecological cell is the basic processing unit for physical analysis in an AEZ study .

../..

[36] Uphoff (1997).

[37] Reported by Keya Choudhury and Louisa Jansen, FAO (1997).

Box 4.2 (cont.d)

Agro-climatic zone
A land unit defined in terms of *major climate* and *growing period*, which is climatically the homogeneous response of a crop or a farming system.

Agro-ecological region
This term was used exclusively to describe Agro-ecological zones in Bangladesh taking into account the physiographic aspect. Those regions coincide with the 34 major physiographic units or their subunits which have been recognized in Bangladesh (*Agro-ecological zones*). Subdivisions of those regions to indicate areas where significant differences in soils and/or depth of seasonal flooding occur within the region are termed agro-ecological subregions.

Agro-economic zones
Zones which are defined in terms of common features from an agricultural point of view. For different purposes these features will differ but may involve such dimensions as climate, soil resources, land use, ethnic groupings, market access, etc..

All the above mentioned spatial contexts and classification systems, however, are found to have some limitations in so far as, taken individually, they do not provide comprehensive information on the complex interactions between the ecological processes and human activities.

Ideally, a more appropriate spatial unit for information collection and decision-making on the environment should be based on the concept of *ecosystem*.

Ecosystem

Ecosystem is a geographical area covering all the interactions between the ecological, socio-economic and cultural factors (field, farm, household, village, watershed, regional production area) and related livelihoods, such as production (plants), consumption (animals and humans), and absorption (water, soils, etc.).

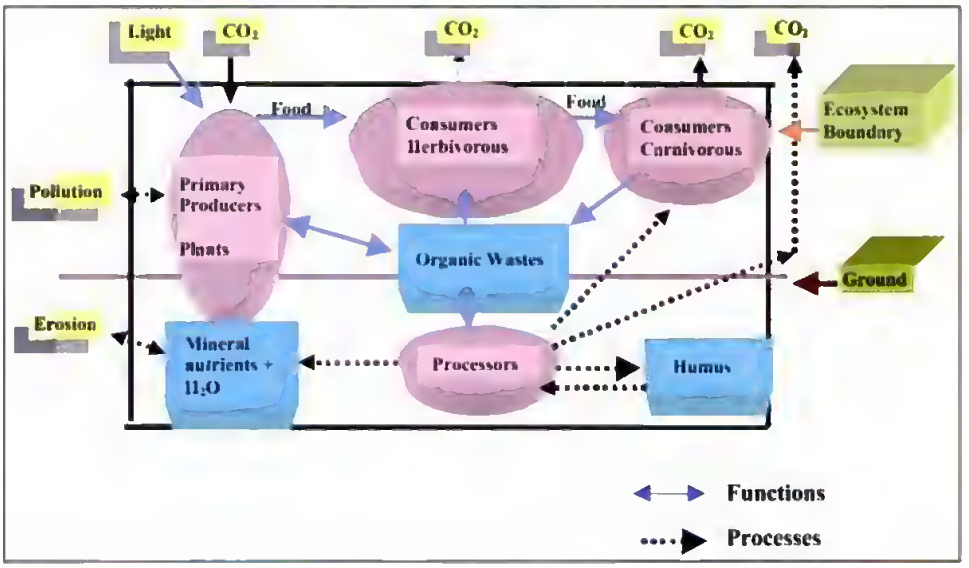
A practical approach commonly used to identify the spatial units more consistent with the ecosystem concept is to **use a combination of existing classification systems according to the issue to be addressed**. So, for example, if the issue is non-point pollution due to agriculture, a combination of land classification systems, agro-ecological zones, watershed systems, and administrative units could provide the basis for:

- a comprehensive analysis of the ecological, social, and economic impacts of pollution;
- the identification of the most suitable measures to be undertaken to solve the problem; and
- the identification of the appropriate institutional level for implementing the measures.

Following Transley[38], who coined the term, ecosystem is defined as "*a recognizable chunk of earth in which the flow of energy and the transformation of matter in-space-in-time creates networks of organisms (such as plants and animals, including humans), atmosphere, rock, soil, and water, interacting with each other and with other ecosystems*".

A graphical representation of an ecosystem is provided in Figure 4.1, wherefrom it can be drawn that the three principal components of ecosystems are: the primary producers (plants), the consumers or secondary producers (animals, including humans), and the processors (fungi, bacteria) that decompose organic wastes of producers and consumers into inorganic nutrients, which in turn are used by the primary producers to produce the biomass and perpetuate the biological cycle. Moreover, ecosystems require a continuous flow of external energy. In the case of natural ecosystems, the only source of energy is the sun, whereas in the case of ecosystems created by humans, solar energy is generally complemented by "artificial" energy such as oil, coal, nuclear. Finally, ecosystems interact with other ecosystems through the exchange of, for example, pollution, soil erosion, etc.

Figure 4.1 Ecosystem functions and interactions with the human activities



Source: Adapted from Gigo, 1974; Zacharias and Kattman, 1981.

Natural ecosystems are able to react to external disturbing actions (auto-regulatory capacity of ecosystems), and therefore are able to achieve a steady biological equilibrium in the long term. The auto-regulatory capacity, however, is limited and if ecosystems are subject to prolonged and intense external actions some functions or components (species) of the ecosystem may disappear, thus leading to a new equilibrium less stable than the previous one.

[38] Transley (1935).

In the case of agricultural ecosystems, for example, the natural equilibrium is altered through the action of farmers who tend to favour the growth of crops by reducing the number of other plant species (or primary producers) with the introduction of herbicides and hoeing machines. A side effect of these practices, in particular with the use of chemicals, is the reduction of the species of processors. Yet, crops need increasing energy and inorganic nutrients to grow. If the agricultural ecosystem is not able to meet the requirements, the only alternative will be to increase the use of fertilizers and chemicals. In other words, the agricultural ecosystem is no more able to achieve the biological equilibrium through its auto-regulatory capacity and depends increasingly on supplies of external and artificial energy.

4.2.2 Information gathering

> "An information-rich and an information-sensitive society is mandatory for sustainable living and an ecosystem approach to management. Knowledge and information allow societies to make more informed decisions about the care and use of ecosystems. Research, for example, can tell us how ecosystem degradation associated with overharvest of a resource might affect society in terms of lost long-term opportunities". (Dovers and Handmer, 1992).

The areas of environmental knowledge and information that deserve major attention can be summarized in the following two major themes: understanding ecosystem composition, structure, and function; and management of human-environmental relationships. In particular, efforts should be devoted to:

- defining and quantifying natural resources in terms of stocks, flows, and distribution;
- describing human-environmental relationships;
- assessing human-caused as well as natural stress affecting natural resources, particularly cumulative impacts;
- valuing the services and goods supplied by the environment; and
- development of data and information management techniques.

Necessary conditions for achieving a higher understanding of the above mentioned issues are education, research, extension, and training, which would contribute to the creation of an *a-priori* knowledge of problems likely to occur in a certain ecosystem, would ease the identification and selection of information and data to look for, and would allow to save time and financial resources. Higher knowledge and information would also facilitate increased participation of stakeholder in decision-making. It is worth pointing out, however, that education, research, extension, and training require financial investments, which are often beyond the capacities of developing countries. Moreover the returns on these investments are in the long term, whereas some environmental problems of developing countries require urgent intervention. Environmental information gathering at the local level can be done by using

the methods generally known as Participatory Rural Appraisal (PRA). A brief description of PRA is provided in Annex 3[39].

4.3 ANALYSIS OF PROBLEMS AND OBJECTIVE SETTING

Consensus on issues and objectives

The main purpose of this activity is to **reach a consensus among stakeholders** on broad as well as detailed issues and objectives, and on long, medium, and short-term objectives. The higher the compatibility of the objectives and goals identified at the area level with the overall development goals at the higher levels, the greater the possibilities of problem solution.

The **selection of the priority issues** or problems facing the area relies primarily on the analysis of information provided by the natural resources assessment exercise, which may be complemented with other information obtained from various sources such as existing strategies and plans, *ad hoc* studies carried out by task forces specialized in various issues (environmental, social, economic), previous studies conducted by governmental agencies, universities, private and public research institutes, other projects or plans addressing the same issues.

The analysis of problems and opportunities will lead to the selection of few priority issues and objectives (too many objectives can be unmanageable) that **reflect the perception of stakeholders, are manageable, and can be monitored and evaluated easily**. Annex 4 gives an illustration on the application of simple tools to carry out such an analysis and to identify stakeholders' interests and responses in order to reach consensus on solutions proposed.

4.4 ACTION PLANNING

The action plan's purpose is to **define a set of projects and policy measures able to achieve the objectives identified**. It will provide details on how the policies and projects will be implemented and the objectives achieved. These direct actions can be completed by indirect actions such as training and education aimed at enhancing the capacity of the management system and enhancing skills among participants.

Each action will be clearly defined in terms of:

- the *alternatives* available to achieve the same objectives;
- the *inputs* and *outputs* required;
- *agents* involved;
- *uncertainty* and *risks*;
- *linkages* with other programmes;
- *budget* and financial plan; and

[39] A case study illustrating the use of rapid methods for natural resource and environmental analysis at local level is in FAO (1998). Xichang Training Case Study on Natural Resources and Environmental Analysis.

- *monitoring and evaluation* arrangements.

4.5 MONITORING AND EVALUATION (M&E)

As stressed by the United Nations ACC Task Force on Rural Development (1985), monitoring and evaluation (M&E) provide the means for development managers, planners, and decision-makers to:

- track the progress of development activities during implementation;
- determine systematically and objectively the relevance, efficiency, and effectiveness of development activities and their impact on the intended beneficiaries; and
- learn lessons for future developing planning.

Together, they allow managers to identify shortfalls or discrepancies between the expected outcomes or objectives and the actual changes and to provide for early corrective actions through revision or improvement of the design and the operation of parts or the whole process.

With regard to the environmental dimension of sustainable development activities, M&E is carried out to assess the impacts of the actions (projects, policy measures, etc.) undertaken on the stock of natural resources, the flows of services and goods they supply, and the functioning of the ecosystem processes. The assessment is based on indicators that help to measure changes due to an activity.

Environmental indicators will:

- measure **quantitative** (quantity of dissolved oxygen in water) or **qualitative** (higher or lower transparency of air) changes;
- be **direct** (the ones cited above) or **indirect** (proxies) when direct measures are not possible or cost-effective (e.g. presence or absence of certain species of animals as a proxy for measuring the quality of the habitat);
- refer to **micro-level** (number of trees planted in one village) or **macro-level** (air quality at the local level) changes; and
- be **disaggregated** (salinity at the local government level) or **aggregated** with other sustainability objectives (e.g. UN Human Development Index, which is constructed accounting for social, economic and environmental factors).

In a sustainable development framework indicators must also be developed on the linkages between environmental, social, and economic dimensions (e.g. how human activities stress or help to restore the environment) in order to assess whether sustainability objectives are achieved.

M&E can be carried out by specialists internal to sponsoring organizations, by external specialized bodies, or by specialists in collaboration with stakeholders.

CHAPTER 5

CONCLUSION

The need to value environment

Until recently environmental issue has been largely ignored in conventional economic analysis and decision-making, whose main objective has generally focused on profit maximization. Chapter 1 explained that the environmental system is a key development factor and that it has a finite capacity to provide for human needs; in economic terms, it is a scarce resource. Though scarcity of environmental resources and services may be very high in certain regions of the world, the economic value generally placed on them is often underestimated and close to zero. In many cases this has led to an unsustainable path of economic growth.

It is also stressed that evidence does not provide a clear response to the question of whether economic growth and environment protection and conservation are conflicting or complementary goals. Rather it shows that trade-offs and complementarities depend on various other factors such as: the scale and the structure of the economic and the social systems, technology, efficiency with which natural resources are used.

Economic, environmental and social dimensions of sustainable development

In addition it is pointed out that economic and environmental issues are two important but not absolute conditions for ensuring a sustainable development. A third dimension, the social dimension, has also to be accounted for because humans are integral parts of ecosystems. Humans and ecosphere are partners in ensuring a good quality of life. It follows that protecting natural resources, their composition, structure, and functions, is protecting humans and life on earth.

Finally, it is argued that as not all of these objectives can be maximized, it is important that trade-offs among them are analysed and made clear and that any decision-making focusing on one or two of these dimensions may not lead to sustainable development.

In the last decades substantial improvements have been achieved in the general knowledge of environment-economy interactions from both the scientific/technical and economic viewpoint, including how future generations can be accounted for in decision-making. Considerable work has also been undertaken to analyse the interactions between some social aspects and natural

resources depletion[40], though more investigation is still required in this area. Further investigation is also needed to understand and measure the interactions occurring simultaneously between the three dimensions.

As a result of this work, decision-making in development planning activity has also undergone substantial changes in terms of both the general approach to decision-making and the analytical techniques and tools.

Decentralized decision-making for the environment

Decentralized decision-making is often considered to be more effective in addressing environmental problems. Chapter 2 concludes that though environmental problems are generally location-specific, there is no valid reason to assume that all related decisions should be taken at the local level.

Even when geographical decentralization is advisable, this does not mean that decision-making at the various geographical levels are independent. On the contrary, decentralization must be thought of as a network of a multitude of decision-making centres linked by the same *vision* for the future, which is usually established on the basis of strategies and plans prepared at the national or international levels. As Ostrom[41] points out "many biological processes occur at small, medium, and large scale. Therefore, governance arrangements that can cope with this level of complexity also need to be organized as multiple scales and linked effectively together. An example is provided by irrigation systems. It is not uncommon to find large irrigation systems at the local government or higher level with multi-level sub-systems, each with its own rules. In this case, smaller level organizations are nested in ever larger governance systems".

Moreover, geographical decentralization does not necessarily require that institutional decentralization goes as far as devolution. Various combinations of forms of decentralization can be found to cope with environmental and natural resources management problems, depending upon the specific conditions. A number of criteria have been suggested to help find the most effective forms of decentralization.

It is argued that centralization and decentralization should not be considered antagonist conditions. In most countries an appropriate balance of centralization and decentralization is essential to the effective and efficient management of environmental problems. Not all functions can or should be financed and managed in a decentralized fashion. And even when national governments decentralize responsibilities, they often continue to play an important role in policy and supervisory functions. They must create or maintain the enabling conditions that allow local units of administration or nongovernmental organizations to take on more responsibilities. Central ministries often have crucial roles in promoting and sustaining decentralization by developing

[40] Stephen Mink (1993) has analysed the interactions between poverty and environment. The Economic Commission for Latin America and Caribbean (1991), also addressed the issues of poverty and population interactions with the environment. Myrdal (1968), Chambers (1986), and Bartelmus (1986) all addressed poverty-sustainable development interactions.
[41] Ostrom (1995).

appropriate and effective national policies and regulations for decentralization and by strengthening local institutional capacity to assume responsibility for new functions.

Role of government

The role of the central and local government in decentralized decision-making is analysed in detail in Chapter 3. It is argued that proper and effective environmentally sustainable decision-making requires profound institutional and cultural change in the society. It entails that environmental concepts be incorporated in the values, attitudes, and behaviours at both society (at any geographical or administrative unit) and individual levels. The government at any level can play an important role in this process through direct investments in the environmental sector, the creation of an incentive system able to guide private entrepreneurs towards a more sustainable use of natural resources, the design of more appropriate institutions or the re-organization of the existing ones.

Also important to achieve the above changes is the adoption of a decision-making approach able to better account for the complexities of the environmental problems and of the sustainability concept. That is, a decision-making framework able to place due importance on:

- capacity-building;
- information and communication;
- co-operation;
- negotiation; and
- consultation and partnership,

which, in turn will:

- improve environmental knowledge and awareness;
- optimize information collection; and
- gain support, consensus, and commitment of individuals in the identification, preparation, implementation, monitoring and evaluation of environmental programmes.

In Chapter 4, the stages of decision-making that deserve particular attention from the environmental point of view are reviewed. It is stressed that two conditions are of primary importance for a proper consideration of environmental problems in decision-making, namely well defined spatial units and information generation. It is also highlighted that participation plays an important role in the collection of the required information, as well as in the identification of objectives, planning of actions and monitoring.

Tools for environmental decision-making

The tools available to perform effective decision-making integrating environmental considerations are examined. It is argued that if the decision-making process may be a resource demanding (both time and human resources) and expensive activity, a number of tools exist, that can reduce the overall costs and which have already been widely used in decentralized planning.

The integration of environmental concern in decision-making at the decentralized level is crucial and urgent if the negative trend in the stock of natural resources is to be reversed.

Annex 1

ECONOMIC AND REGULATORY INSTRUMENTS

Economy-wide policies are beyond the control of district level administrations, thus they will not be addressed in this document. However, exchange rate, trade and fiscal policies have substantial influence on relative prices and incentives in the use of natural resources at the decentralized level. It is, therefore, important that decentralized level actions and policies aimed at achieving environmental and sustainability objectives be compatible and fit within the framework of the economy-wide policies. The tight relationships between national and local policies also entail that environmental objectives at the decentralized level cannot be achieved if environmental considerations are not incorporated in economy-wide policy decisions.

In this section a number of policy tools available at the district level are discussed. These encompass command and control, economic and institutional instruments.

COMMAND AND CONTROL INSTRUMENTS

Sometimes also named regulatory measures, command and control instruments are generally aimed at reducing or minimizing the impact of human activities on the environment through restrictive laws, or at prohibiting certain activities. Therefore, they generally lead to some erosion of individual freedoms in the society. However, as long as environmental degradation continues and options decrease, some form of prohibition and restriction will be necessary to control the access and use of declining renewable and non-renewable natural resources. Among the most widely used regulatory instruments to protect the environment are:

- **standards** (e.g. gas emissions from cars cannot exceed a threshold value);
- **quotas** (e.g. kilograms of mushrooms that can be collected per capita in one period), **permits** (e.g. release of wastewater into rivers);
- **licenses** (e.g. hunting of whales or game animals);
- land use controls such as **zoning**; and
- building controls in areas of particular environmental or cultural interest.

All these instruments can be easily used at the district level because they are often related to location-specific environmental problems and are not required to be uniform throughout the country. These instruments are categorical in the sense that they leave

individuals and enterprises with no choice but to comply with the existing regulations. Often they are associated with penalties and fines.

In addition to the above instruments, **property rights** and **land tenure** systems are also regulatory measures that may help improve the management of natural resources. As Calabresi and Melamed (1992) pointed out, property rights can take the form of property rules, liability rules, or inalienable entitlements. Carlson *et al.* (1993) also add that in order for markets to lead to an efficient allocation of natural resources, property rights to the resources must have some degree of four characteristics:

- ownership,
- exclusivity,
- transferability, and
- enforcement.

Ownership provides the owner with the right to use the resource. Exclusivity ensures that all costs and benefits will accrue only to the users. Transferability implies that property rights are tradable. Finally, enforcement is the condition for the property rights system to be effective. It must also be pointed out that property rights effectiveness will be higher if they are coupled with well developed markets.

However, in real life there are no pure private rights. Exclusivity, which is the main distinction between a private property resource and an open access resource, is seldom respected because many activities produce externalities. So, for example, the odour from a pig farm may make the neighbour's property value decline, thus producing a negative externality or a cost accruing to someone else. In this case the exclusivity condition fails. Because of the difficulty to comply with all the above conditions, property rights systems are often complemented by other policy measures, such as standards, charges, taxes and so forth.

On the other hand, shifting from a traditional tenure system to a private one may generate other externalities detrimental to the environment (e.g. short leasehold terms may lead to the intensification of crops growing on steep slopes). It is therefore important that property rights and land tenure measures be: (i) accompanied by other policies aimed at avoiding the possible environmental impacts, (ii) introduced gradually in order to leave time for creating awareness among land users and providing information about changes occurring in tenure arrangements.

Some simple and basic rules for setting up an effective regulation framework at the district level are the following:

- Ensure that skilled staff and financial support for the programme administration exist;
- Train the personnel that will be responsible for the collection of fines and penalties;
- Adopt a realistic set of standards which can be easily monitored and enforced;

- Define precisely the criteria against which the outcomes of regulations will be measured to avoid situations of unreasonably stringent and cost-ineffective regulations;
- State clearly how the programme will be implemented.

ECONOMIC INCENTIVES

Economic incentives or market-based instruments include:

- charges;
- taxes;
- subsidies;
- deposit refunds; and
- tradable permits.

Charges and taxes are aimed at reducing the use of products or activities that may have adverse effects on the environment and are based on the Polluter Pays Principle. Charges are usually related to the provision of a service (e.g. water treatment and conveyance) whereas taxes are not (e.g. taxes on leaded petrol).

Subsidies, on the contrary, are intended to promote the consumption of environmental-friendly products or activities (e.g. subsidies on land conservation practices).

Deposit refunds encourage potential polluters to dispose of harmful goods safely by placing a surcharge on the price of the good, which is reimbursed when it is safely disposed of (e.g. plastic, cans, and glass disposal schemes).

Tradable permits (OECD, 1995) entail trading the right to pollute among potential polluters. In other words, potential polluters are allowed to buy and sell emission quotas within the limits of emission standards. With this mechanism, polluters who introduce less polluting processes economize on their quotas and are free to sell them to other polluters who cannot manage with their quotas[42].

The choice of the most appropriate economic instrument depends on the characteristics of the environmental problem to be solved. For example, deposit refund systems are better suited for products which can be reused, whereas emission charges should be preferred for stationary pollution sources and in situations where marginal abatement costs vary across polluters.

However, some general criteria in the choice of the most appropriate policy measure can be identified. Following the suggestions of OECD (1991), these are:

[42] Valuable contributions to the analysis of environmental policy instruments are: Coase (1960), Baumol and Oates (1975), Buchanan and Tullock (1975), Pearce and Turner (1990), *Carlson et al.* (1993), Panayotou (1994), OECD (1995).

- *environmental effectiveness*, i.e. the capacity to achieve the environmental objective (e.g. reduce the local concentration of a given pollutant to pre-set standards);
- *economic effectiveness*, i.e. least cost (both direct costs and indirect costs in terms of opportunities foregone) policy measures should be used to achieve the same environmental objectives;
- *equity*, distributive impacts of policies should also be accounted for. For example, equal discharge standards may imply widely unequal marginal and/or total abatement costs between polluters and pollutees;
- *administrative feasibility* and costs, these relate to the costs of monitoring and enforcement of the policies; and
- *acceptability*, the higher the involvement of target groups in the identification of the most appropriate policy measure, the higher the probability of success of the instrument chosen. It implies adequate information, consultation, and phased implementation in order to leave the potential polluters the necessary time to adapt to the new situation.

Though in theory all the above instruments could be applied at the district level, there is little evidence of these being actually used in the developing countries. This is mainly due to the following factors:

- decentralization is rarely accompanied by real empowerment of lower level administrations;
- lack of skills in their use and in the assessment of their impacts; and
- absence of well developed market mechanisms and institutions.

ADVANTAGES AND LIMITATIONS OF COMMAND AND CONTROL AND ECONOMIC MEASURES

The major **advantage of command and control** measures is the higher familiarity of decision-makers with these instruments when compared to other measures such as economic instruments.

The major **limitations** encountered in the use of the above instruments is the enforcement capacity. The evidence shows that the application of these instruments fails when they are poorly enforced. It is frequent that while regulations are stringent, penalties and fines are very low, so that, for example, potential illegal bark harvesters will balance the private risks of not complying with the private cost of compliance. Another reason for failure is the poor institutional setting and administration of the collection of penalties and fines. So it often happens that, even with stringent regulations and high fines, the system fails because of lack of trained personnel responsible for the collection of fines and penalties. This is, for example, one of the most important reason of illegal hunting of protected animal species in Natural Reserves. Moreover, command and control measures are usually less cost effective than economic measures. They are also less dynamic in the sense that they are not able to provide continuous incentives to improve, innovate, adopt the desired behaviour

towards environmental impacts. Their flexibility to changing economic and environmental conditions is relatively low.

The major **advantages of economic measures** are their cost-effectiveness, higher flexibility and capacity to provide dynamic incentives.

Among the **disadvantages** are: the difficulty to set the efficient level of taxes and charges from the economic point of view; they work better when markets are not distorted (which is not the case of many developing countries); some of them (notably tradable permits) are seen as a license to undertake environmentally unsustainable activities; they are often considered to be responsible for unbearable production cost increases (namely, pollution charges).

Institutional measures. Several times in the previous sections, mention was made of the poor capacity of the prevailing institutional setting in developing countries to tackle the environmental problems. A review made by the World Bank (Lampietti and Subramanian, 1995) concluded that, though institutional reform is a prerequisite for environmental problems to be dealt with adequately, little evidence exists of countries undertaking such reforms.

The review reveals that the major constraints to institutional reforms are the established bureaucratic organization of institutions, the strongly organized lobbies, and the behaviour of these bureaucracies and lobbies tending to maintain economic privileges. Even the countries with a decentralized institutional system show a rigid and vertical institutional structure which prevents the necessary inter-sectoral information exchange and policy decision-making required to cope with environmental problems. Moreover, as mentioned earlier, decentralization is seldom coupled with actual empowerment.

The review points out that the major institutional weaknesses of the countries reviewed are: (i) inadequate skills and personnel; (ii) lack of political and public awareness; (iii) gaps and duplication; (iv) competition and lack of co-ordination; (v) poor monitoring and enforcement; and (vi) inadequate legislative framework.

With regard to the recommendations to overcome the institutional problems, 73 percent of the countries reviewed mentioned new legislation standards, 70 percent training and capacity building, and 55 percent working group co-ordinating agencies. A lower number of countries mentioned the necessity to introduce institutional reforms as such, notably: new environmental units (39 percent), private sector/NGO involvement (33 percent), and decentralization (27 percent).

As far as decentralization is concerned, the reform was an important issue for only 14 percent of the African countries reviewed, and 20 percent of the South Asia countries, whereas it represented the second important issue after new legislation standards for Central and Eastern Europe (71 percent of Eastern European Countries reviewed).

According to the review, therefore, it may take some time before important institutional reforms take place in developing countries. This contrasts with the urgency of environmental concerns which require that immediate steps be taken to improve

environmental management at the district level. The countries reviewed provide some important suggestions on actions that can be undertaken immediately at the district level with no need of intervention from central government. These are: (i) training and capacity building within the institutions involved in natural resources development; (ii) improving the coordination and information exchange between the agencies involved; and (iii) involving private organizations.

Though there is not an optimal institutional framework for environmental and natural resource management at the district level, some general features of an ideal institutional system are: (i) flexibility of the model; (ii) capacity to generate information and create awareness of the importance of environmental problems among the decision-makers at all levels; (iii) decentralized decision-making and enforcement; (iv) involvement, clear role, and consensus of stakeholders (governmental agencies, non-governmental organizations, community groups and other associations) in environmental management; and (v) a high-level political support and will.

Annex 2

MONETARY VALUATION OF ENVIRONMENTAL GOODS AND SERVICES

A number of tools, more or less sophisticated, exist to rank and prioritize environmental problems using **monetary valuation methods**. The most widespread are classified in the table below and briefly described in the next paragraphs.

Box A2.1 Monetary valuation techniques

Conventional market*	Implicit Market	Constructed Market
• Productivity change • Preventive or defensive expenditures • Replacement costs • Restoration or reclamation costs • Shadow projects • Substitute costs	• Travel cost method • Wage differential • Hedonic pricing	• Artificial market • Contingent valuation

* Conventional markets means that the valuation is made using market prices; implicit markets means that prices used are obtained by observing the market prices of goods and services strictly related to the good or service to be valued (for example, the cost of air pollution can be estimated by calculating the impacts of pollution on the market prices of houses), constructed markets means that the prices are obtained through questionnaires, which simulate hypothetical markets of a good or service (say, scenery).

Source: Adapted from Munasinghe (1993).

Productivity change. The environment is considered here as a production factor. Changes in environmental quality lead to changes in productivity and production costs which in turn lead to changes in prices and outputs. The environmental benefit of the project will be the additional benefit in terms of crop production generated by the reduction of soil erosion in the "with" project situation as compared to the "without" project situation. One important criticism to this method is that it does not take into account behavioural and market responses to changes in the quantity or quality of the environmental attribute. Farmers, for example, can react to soil erosion either by changing cultivation practices or by applying different quantities of organic and inorganic fertilizers. Moreover, the prices of agricultural crops may change because of changes in crop supplies. And it may be that welfare effects of price changes are higher than yield effects.

Box A2.2 A simple application of the productivity change method to land degradation

The productivity change approach measures the production lost as a result of land degradation. A simple formalization of this method is as follows:

Production loss = production from non-degraded land – production from degraded land

With the condition that there is no change of technology and management practices.

Let us assume that 500 000 ha of our land is under cereals. Let us also assume that all the land under cereals is affected by strong degradation effects, which generates 75% of production loss. If the average yield of cereals is 2 t/ha, the total production of cereals on non-degraded land would be 1 000 000 tons, but since strong degradation causes a reduction of 75% of production, the total production on degraded land will be only 250 000 tons (i.e. 1 000 000 – 75% 1 000 000 or 1 000 000*0.25).

Now assume that the price of cereals is on average US$150. The total value of the potential production on non-degraded land would be US$150 million (150*1 000 000) and the actual value is US$37.5 million (150*250 000). The difference, US$112.5 million, is the total damage cost due to land degradation.

Defensive or preventing expenditures. Often individuals and communities spend money for mitigating or eliminating damages caused by adverse environmental impacts. This is the case, for example, of extra-filtration for purifying polluted water, etc. These expenses can be considered as the minimum estimates of the benefits of mitigation, since it is assumed that the benefits derived from avoiding damages are higher than the costs incurred for avoiding them. The advantage of this technique is that it is easier to estimate than the environmental damage.

Shadow projects. This method refers to the costs of providing an equal alternative good or service elsewhere. The possible alternatives are: asset reconstruction (i.e. providing an alternative habitat site for a threatened wildlife habitat); asset transplantation (i.e. moving the existing habitat to a new site); asset restoration (i.e. enhancing an existing degraded habitat). The cost of the chosen option is added to the basic resource cost of the proposed development project in order to estimate the full cost. Inclusion of shadow-project costs gives an indication of how great the benefits of the development project must be in order to outweigh the losses it causes. In other words the shadow project approach provides a minimum estimate of the presumed benefits of programmes for protecting or improving the environment. Sometimes (Dixon *et al.*, 1994), asset reconstruction (replacement) and asset transplantation (relocation) are classified separately from shadow projects approach although the rationale is similar. The underlying idea is that the reconstruction cost approach, by measuring the costs of reconstruction, gives an idea of what would be the benefits from measures taken to prevent damage from occurring. The same example as before can be used. If a development project leads to the destruction of the habitat, one way to measure the benefits from preventing this damage from occurring would be to estimate the cost for reconstruction. Yet, if reconstruction costs are higher than the benefits of the productive resource destroyed (habitat), it would not make sense to replace the resource lost. If reconstruction costs are lower than the value of the resource destroyed,

it would be efficient to let the damage occur and to replace the productive resource. In other words, reconstruction costs are considered as the "upper limit" of benefits. This rule however holds when benefits and costs can be estimated in quantitative as well as in monetary terms. In the particular case of the habitat, the estimation of the benefits are rather complex. Given the important component of non-use values (option and existence values), it would be wiser to look at reconstruction costs as the "lower limit" of benefits and to choose the alternative with the lowest level of uncertainty

Substitute costs. The substitute or alternative cost approach refers to the cost of available substitutes for the particular unpriced service or good. For example, manure may be considered as a substitute for fertilizers. If the two alternatives provide the identical service, the value is the saved cost of using the substitute. An example is provided by Misomali (1987) reported by Price (1989). In a study on fuelwood plantations in Malawi, the author priced fuelwood on the basis of the saved kerosene imports. Newcomb (1984) looked at fuelwood as a substitute for dung for domestic heating. Dung was thus made available as a fertilizer, and the cost of chemical fertilizer imports (in fact imports plus internal marketing costs) was saved. Therefore, the resulting shadow price for fuelwood was the saved cost of imports of chemical fertilizers. The validity of this approach depends upon three main conditions being respected: (i) that substitutes can provide exactly the same function of the good or service substituted for, which is seldom true especially in the case of environmental goods; (ii) that the substitute is actually the least-cost alternative; and (iii) that willingness to pay (WTP) evidence indicates that per capita demand for the service would be the same.

Wage differential approach. This technique assumes that the wage rate paid for a job reflects a set of attributes, including environment and health safety. It follows that other things being equal, employees will seek higher wages to compensate for higher risks. The price for safety (also called Hedonic wage) is the difference between what would be the wage with the same attributes but risk and the wage including safety risk. The assumptions required for this technique to work are that: (i) labour markets functions freely; (ii) labour is mobile; (iii) it is possible to isolate the exclusive impact of risk on wages; (iv) perfect comparability between different types of risks; and (v) good quality of information on risks.

Hedonic pricing method (HPM). HPM seeks to estimate some assets by linking real estate prices or wages to environmental attributes. It estimates the differential premium on property value derived from proximity to some environmental attributes. In order to obtain a measure of how the environmental attribute affects the value of houses, all other variables of houses (number of rooms, central heating, garage space, etc.) are standardized. Moreover, any unit of housing is completely described by locational, neighbourhood and environmental attributes. Assume, for example, that one wants to assess the landscape improvement value of a forest. HPM will first estimate the marginal WTP of individuals/households who decide to buy or rent a house with the same attributes but the quality of landscape. Then it will specify the demand function for this attribute and estimate individual/household consumer surplus. The last step will be to aggregate all the individual consumer surpluses in order to obtain the total value of the landscape improvement. Although it has been widely used, this method has several limits in its application. The most important of them may be the quantity of variables required, which are seldom recorded in the official statistics even in

developed countries. Brookshire *et al.* (1982) identified no less than eighteen variables necessary in the analysis of housing market, most of which must be estimated. Another disadvantage is the huge amount of data required (time series or cross section). The quantity of data required increases when the demand function must be estimated on the basis of income and other socio-economic data as well as the supply of houses on the market. Reliability of data is also considered a shortcoming of this method. House prices, for example, are often distorted and owners of houses frequently accept to sell or rent at lower prices than the maximum offer received, therefore the observed price may not correspond to the marginal WTP. Finally, this method does not capture non-use values and does not take into account the effect on prices of individuals/households' expectations on the future quality of landscape (Ablest *et al.*, 1985).

Travel cost method (TCM). The basic model developed by Trice and Wood (1958) and Clawson (1959) is based on the expenditures incurred by households or individuals to reach a site as a means of measuring willingness to pay for the recreational activity. The sum of cost of travelling (including the opportunity cost of time) and any entrance fee gives a proxy for market prices in demand estimation. By observing these costs and the number of trips that take place at each of the range of prices, it is possible to derive a demand curve for the particular good. Two main variants of TCM exist: the Zonal Travel Cost Model (ZTCM) and the Individual Travel Cost Model (ITCM). The main difference being that whereas the ZTCM divides the entire area from which visitors originate into a set of visitor zones and then defines the dependent variable as the visitor rate (that is the number of visits made from a particular zone in a period divided by the population of that zone) the ITCM defines the dependent variable as the number of site visits made by each visitor over a specified period. There is a general agreement in considering TCM as one of the most effective approaches in valuing recreation services (Bockstael *et al.*, 1991; Smith, 1989; Ward and Loomis, 1986), nevertheless, as Smith (1993) points out, this model has been used so far to define "the demand for and value of services provided by specific types of recreation sites and not to estimating the value people place on changes in the sites' quality features". Furthermore, the decision to use either zonal or individual TCM approaches is likely to have a significant impact on the results obtained. Finally, similarly to the other techniques addressed above, TCM only measures the "use value" of recreation sites. Other potential problems encountered with this method are the following: (i) determination of the opportunity cost of on-site and travel time; (ii) treatment of substitute sites; (iii) choice of the appropriate functional form and its impact upon consumer surplus estimates.

Contingent valuation method (CVM). This technique is by far the most widely used among those belonging to the expressed preferences methods. Basically it consists of asking people (usually via a questionnaire or by experimental techniques[43]) what they are willing to pay for a benefit or what they are willing to receive for compensation for the damage received. In fact, the questionnaire simulates an hypothetical (contingent) market of a particular good (for example, landscape quality) in which individuals (the demand) are asked to reveal their willingness to pay for a change (better/lower quality) in the provision (the supply) of the good in question. The questionnaire also provides information on the institutional context in which the good

[43] People are asked to respond to stimuli in laboratory conditions.

would be provided and on the payment vehicle. The major advantage of this approach when compared with the others is that it may in theory be applicable to all goods and services (use and non-use values), whereas it is the only possible technique in the evaluation of non-use values. Another attraction of this method lies in the fact that it does not require the huge amount of data (often not available or unreliable) necessary to the other techniques. Several criticisms have however been moved to the accuracy and reliability of consumer preferences resulting from CVM. The major one concerns the biases inherent in the techniques[44] (mainly strategic bias or the free rider problem, starting point bias, information bias, vehicle bias, hypothetical bias). Another source of skepticism about this method is the disparity emerging in empirical studies of CVM between willingness to pay and willingness to accept (Mitchell and Carson, 1989; Knetsch, 1990; Pearce and Turner, 1990). Although many of these problems are not yet totally solved, steps have been taken in the last decades, particularly in the design of questionnaires and in the interpretation of results, which have considerably improved the findings (Brookshire and Coursey, 1987). As pointed out in a review by Kerry Smith (1993), the comparison between findings obtained with CVM and other methods are substantially consistent.

[44] For a detailed discussion on biases in CVM, see Mitchell and Carson (1989).

Annex 3

PARTICIPATORY RURAL APPRAISAL (PRA)

The Participatory Rural Appraisal (PRA) method is an evolution of Rapid Rural Appraisal (RRA) and was developed in the 1980s in response to the poor quality of official data and information and to the perceived problems of external experts and technicians miss-communicating with the local people in the context of development work. **For gathering statistical data, data collection and analysis are undertaken by local people with the external experts and technicians acting as facilitators.**

Three main principles should be considered when applying informal methods for information collection: **triangulation**, **flexibility**, and **multi-disciplinary team-work**.

- **Triangulation** involves that information should be obtained from several perspectives which can be achieved either through the selection of units of analysis (e.g. farmers, households, individuals, etc.) or data collection techniques (e.g. mapping, scoring, diagramming). The composition of the survey team (e.g. gender, age, experience) can also contribute to the cross-checking of the information collected.
- **Flexibility** means the absence of a rigid protocol and the possibility to change techniques and tools according to the needs arising. It does not mean however, as pointed out later in this section, that informal methods do not require proper planning before the beginning of the investigation activity.
- **Multi-disciplinary team-work** stands for the composition of a team of individuals with different professional backgrounds which ensures comprehensiveness and quality of information collected.
- **Preparation of the surveys.** The investigation activity should be planned accurately before it begins. In particular, **clear objectives** should be stated to better focus the field work and obtain relevant conclusions; **team composition size, training, number, role,** assured to avoid miss-interpretations and miss-understandings once the field work has started; **samples and stratification** of the area and population should be decided in order to select smaller sub-sets of representative population or area to be investigated; a **set of possible tools** of investigation can be decided in advance, though changes may occur during the investigation exercise; use of the **results of previous work** can be helpful in planning the investigation work and in the analysis of the results; finally, during the field work **direct observation** of important indicators may be useful to cross-check findings and to avoid being misled by rumours.

A summary of the main steps for conducting an informal survey is provided in Box A3.1.

Box A3.1 Planning and conducting an informal survey – Main steps

Before the survey
1. Select multi-disciplinary survey teams
2. Analyse secondary data
3. Prepare checklist for the interview
4. Prepare the logistical side of the survey
5. Inform the interviewees and fix appointments
6. Establish note-taking procedures before meetings
7. Training of the team

During the meeting
1. Respect the local culture and language
2. Interviewees must be considered as equal partners
3. The checklist is a means to stimulate discussion and participatory dialogue, not a questionnaire.
4. Organize questions on the basis of sub-topics
5. Use the following six helpers: Who? What? When? Where? How? Why?
6. If possible, organize the information and notes using some selected tools during the meeting. If not, organize them right after the meeting.

After the meeting
1. Have evening brain-storming sessions with the team to complete your notes and make sure that you do not forget useful information.
2. Prepare the meetings of the following day.
3. Establish report writing procedures within the team.

According to the type of data and information required (spatial, time-related, and people-related, technical, institutional) several tools can be used. More than 30 PRA tools are available for this purpose (World Resource Institute, 1991b), many of which can be useful for environmental analysis. Below the most important of them are briefly illustrated[45].

Tools

- **Spatial data**. Maps and transects are useful tools for collecting and presenting environmental data and characteristics of the area.

  ➢ **Maps** show the location of environmental resources (water, forests, etc.), activities (agriculture, industry, etc.), landscape ecology (slopes, vegetation, particular habitats, etc.) potential (areas suitable for improved production) and problems (water shortages). Specific maps can be drawn for each environmental resource (soil, water, air) conditions. As regards environmental problems, the maps should be able to incorporate both the location where the problem is originated and the location where its effects take place. In other words, ideally, the map and the study area should be extended up to the level where all causes and effects of the

[45] For more details the readers are referred to FAO (1998).

environmental problem are accounted for. This will facilitate the identification of the stakeholders to be involved in the survey exercise, as well as the most relevant and cost-effective policy measures or actions to be undertaken to solve the prohlem. It helps to determine the most appropriate actors for implementing the measures selected.

Unfortunately, often the location of the origin of problems is very distant (sometimes in other countries) from the area where the effects take place. For example, the causes of water shortage may be due to the construction of a dam upstream, very far away from the study area. In this case, it may he worth drawing two different maps: one of the study area, which provides the analysts with detailed information on the location of effects and their severity, and one more general showing the location of the source of the problem with respect to the study area.

Depending on the purpose of the study, the information contained in the map will change. So, for example, if you are interested in analysing the prohlem of land degradation, you will probably be willing to know who is affected, what activities may suffer from it, how severe the prohlem is and where it is most severe. Additional information may be the road network, the type of soils, the slopes, etc., which may be useful in identifying possible solutions. A conceptual approach for drawing a map containing the above information is provided in Figure A3.1

➢ **Transects** add further details on specific characteristics of the environment (slope, drainage, vegetation, water, soils, other resources) which contribute to refine the understanding of the area and interactions between the physical environment and human activities. Information is generated through direct observation and discussion with the villagers or target groups while walking a predefined distance in the study area. An example of a transect elaborated in the course of an informal survey is illustrated in Figure A3.2 helow.

This tool is particularly important: (a) when there are a range of land use systems in one area; (b) to gain information on constraints and opportunities in the area; and (c) to stimulate discussion with the local communities. Sometimes, when many features must be analysed and long distances are necessary, it is more advisable to create several short transects instead of one long one.

Recording the findings may be rather difficult because it should be done while walking. It is therefore advisable to stop each time a new feature or object is analysed (water availability, land tenure system, etc.). It is also suggested to divide responsibilities between the team members. For example, one may focus on the environmental resources, another on the institutional aspects (e.g. land tenure), another on the socio-economic aspects.

- **Time-related data**. Time lines, trend lines, and seasonal calendars are useful tools to describe and present environmental information over time.

➢ **Time lines** are particularly suited to understand better the most important events, problems, and achievements of the past and how these have influenced the behaviour of people towards the management of natural resources. They also allow

to ask people about possible opportunities to resolve current problems. A typical time line analysis of environmental related issues can be presented as in Figure A3.3.

➢ **Trend lines** allow to understand the changes and the evolution of environmental resources. For example, trend lines can be constructed on rainfall, soil loss, tree planting and animal species changes over time. On the basis of this information, it will be possible to identify positive and negative changes, key changes and, finally, the major problems faced by the communities. An example of trend line is provided in Figure A3.4. Trend lines can also be constructed in a participatory manner. In this case it will allow the facilitator to understand how people perceive the changes over time.

➢ **Seasonal calendars** help organizing various types of information in a common time frame (usually one year). For example, they allow to compare monthly labour availability with labour demand, or labour availability with the cropping pattern. One important environmental related information provided by seasonal calendars is rainfall distribution during the year. In Figure A3.5 below an example of a seasonal calendar is illustrated, which shows the rainfall distribution during the year.

Figure A3.1 Opportunities and threats of Biodivia District

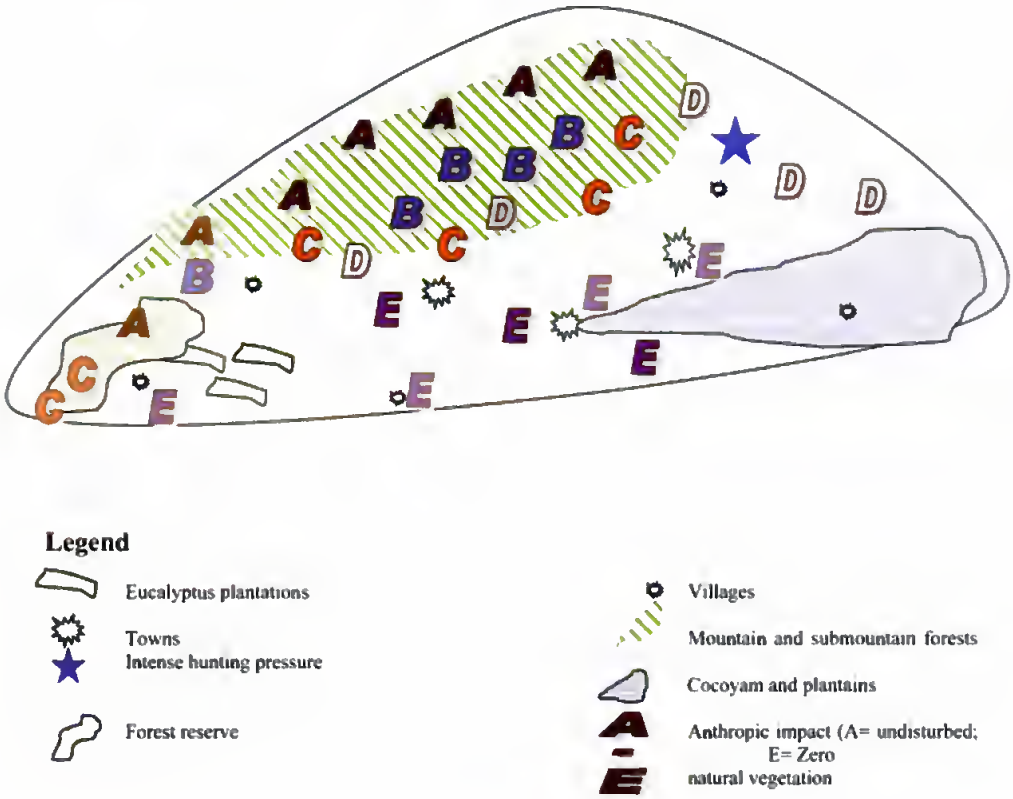
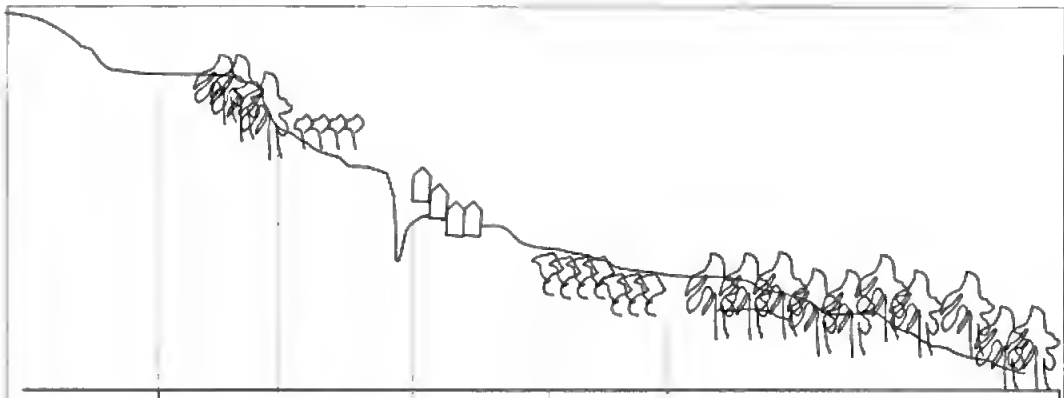


Figure A3.2 Example of a transect walk in Biodivia District



Soils	Red-yellow podzolic	Well-drained shallow			Deep, fertile andosols
Forests	Cloud forest	Sub-mountain forests			Large plantations
Fauna	Primates	Birds, butterflies			
Water					
Activities	Fuelwood collection, pharma-ceutical	Hunting picking fuel-wood	Village	Cocoyam plantains	Tea, eucalyptus
Problems	Extinction risks for primates	Overex-ploitation	No water, health facilities, electricity	Soil	Sensitive to clearance: erosion, run-off, flash floods
Opportunities	High conserv-ation value	Weed control		Terraces	Contour hedgerows

Figure A3.3 Historical timeline for one community in Biodivia District

Year	Events
1954	Little cropland, mainly pasture and wasteland in village
1964	Pasture land and forests conversion to crops
1980	Immigration of strangers
1985	Pasture land and forests conversion to crops accelerate
1990 & recent years	Fallow period shortening
Recent years	Severe erosion

Figure A3.4 Trend line for long-term rainfall

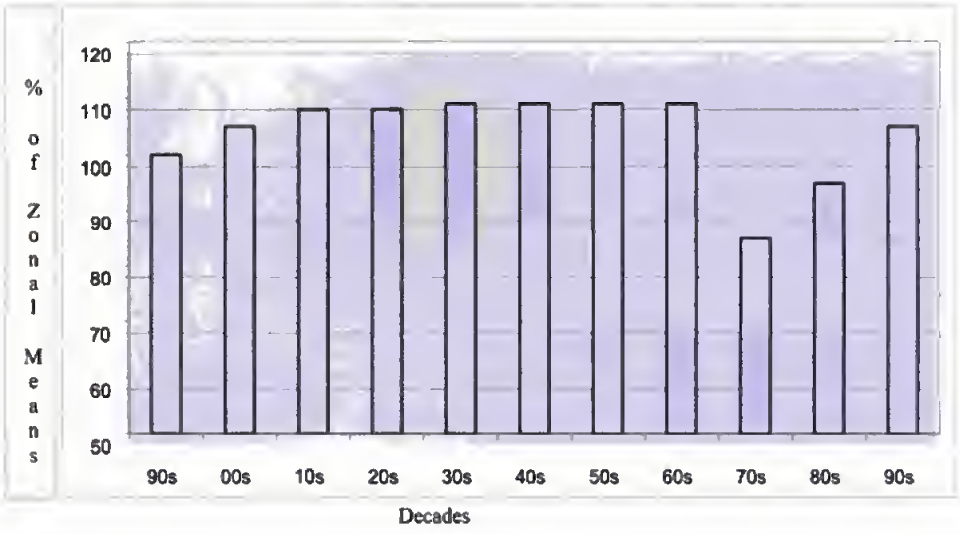
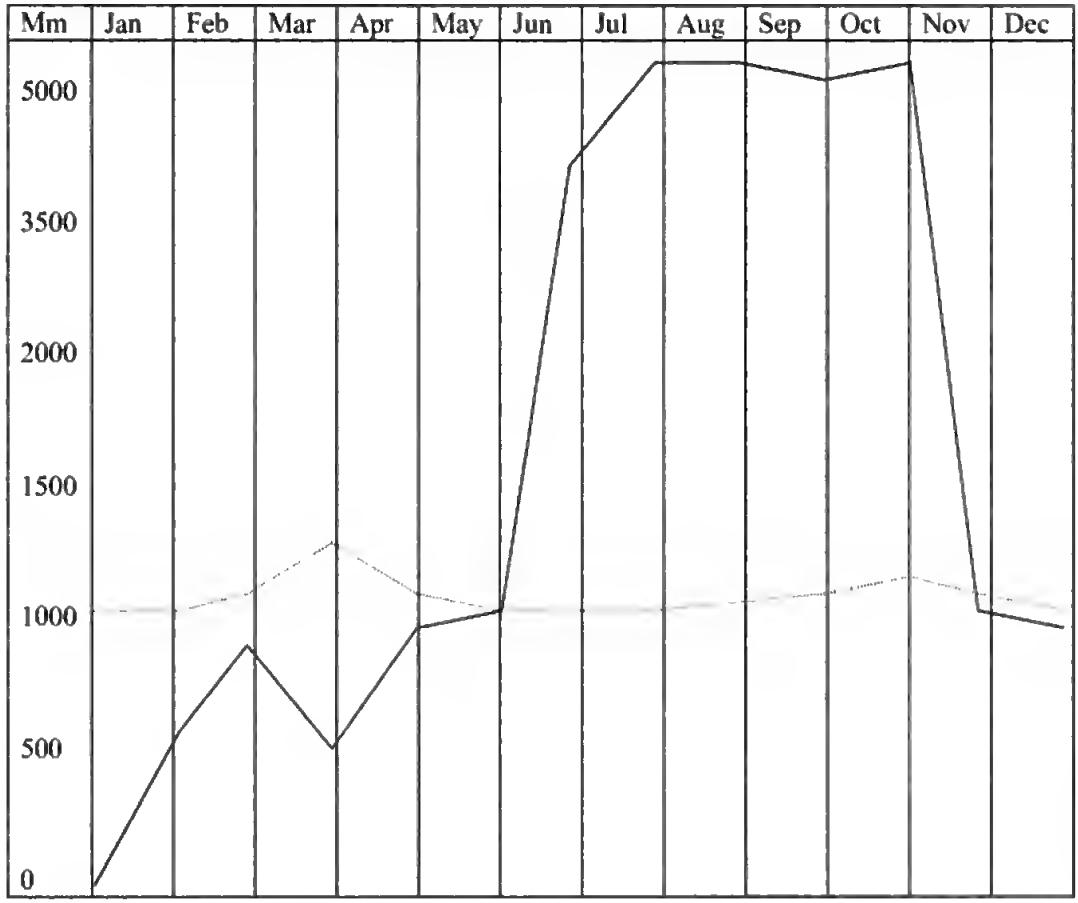


Figure A3.5 Seasonal calendar of rainfall and evaporation in Biodivia District



Legend
_____ Total rainfall
_ _ _ _ _ Evaporation per month

The major steps for planning the use of the above tools are described in Box A3.2 below.

Advantages and limitations

- The **advantages** of informal methods lay on their high **flexibility** (they can be adapted to the purpose of the investigation, they are able to provide specific types of information); **low demand of resources**, particularly time and budgets; ability to ensure **comprehensiveness** of data and information collected by providing answers to the *who, what, when, where, how, why* questions; capacity to **involve the stakeholders** to think systematically about their problems and possible solutions.

Box A3.2 Steps to consider for the use of informal tools

1. Checklist of the features to consider and any associated issues to be discussed about each of them (e.g. physical infrastructure, water sources, cropping systems, woodlands, land tenure systems, grazing areas, infrastructures, and so forth).
2. Identification of the participants. It is important that they represent the group you wish to consult.
3. Explain the purpose of the tool to the groups of participants.
4. Equipment. Almost all the tools can be used with simple equipment. Maps, calendars, lines, can be produced on the ground, on the floor, or on paper. The choice will depend on the circumstances and on the preferences of the participants.
5. Drawing. The use of the tools should involve the participants, who must agree on the variables placed in the maps, calendars, trend lines and time lines.
6. Copy the findings on a piece of paper. If the maps, calendars, lines have been drawn on the floor or on the ground, they will have to be copied when they are completed.
7. Discuss the final product. The findings should be used as the basis for discussion on the features considered. Notes on the discussion will help to better explain and understand the outcome of the exercise. The final copy of the tools used should be approved by the participants and one copy should be left with them.

It is worth pointing out that all the tools presented are a means for analysing the issues and questions of the checklist and not just an output. Therefore, while drawing the maps, lines, calendars, the facilitators should also stimulate the participants to express their views on the problems and opportunities.

- The **limitations** of these methods are that: they are not advisable to create **databases** that can provide valid quantitative estimates (e.g. information such as 25 percent of the population is suffering from the effects of air pollution); the **selection of key informants** is often biased and elitist in the sense that there is a tendency to select key informants on the basis of their status (village *élites*) rather than on their knowledge and experience; **distortions of judgements** are possible if interviewers are not experienced and have a preconceived approach in the interpretation or recording of the answers provided by the key informants.

To **conclude**, in general, the optimal approach to information and data collection would be to combine formal methods with informal methods. The relative importance of the two sets of methods will depend on a number of **criteria** such as the objectives pursued, the skills of the analysts, the equipment available, as well as the time and budget allocated.

Annex 4

XICHANG TRAINING CASE STUDY ON ENVIRONMENTAL AND NATURAL RESOURCES ANALYSIS[1]
- SELECTED ANALYTICAL TOOLS -

(Excerpt)

by

K.C. Lai, Wang Yiqian and Li Shengzhi

[1] This case study (FAO, 1998) was prepared as part of FAO's training and technical support activities in decentralized rural development planning in Sichuan Province in 1998.

Contents

Analytical Framework

Within an administrative area such as a county, practical questions concerning natural resources and the environment would include issues such as: what and where are existing resource endowments, including their quantity, quality, and characteristics; current usage of various resources, and their environmental status and trends; who are the interest groups or stakeholders in a given resource use issue; the causes and effects of resource degradation; relationships between different resource uses and users; and whether there are potential conflicts of interest and tradeoffs in development objectives. Knowledge of these would assist in determining development priorities and setting of environmental goals.

Put another way, the analysis should help answer questions of a what, which, where, when, who, why, and how (and sometimes "what if") nature. In this case study, such questions are given sharper focus by using an analytical scheme that paid special attention to: a) planning theme and utility of the analysis; b) type and scale of analytical unit; and c) cause-effect relationships affecting the environment.

Planning Theme and Utility. Within the ambit of decentralised rural development planning and management , the practical utility of environmental analysis at county level and below are to be found largely in the following thematic areas:

i) area strategic planning;

ii) development project planning[2]; and

iii) development facilitation, including information exchange, coordination, conflict resolution, and mediation/ negotiation processes.

Choice and Application of Analytical Tools

The foregoing provides an organisational basis for the analyses which follow. The latter are grouped according to their utility under strategy planning or development facilitation themes. Eight sets of analytical tools have been selected. These are shown below page together with the main question being addressed.

Analytical Tool	Main Question Type
Group I. County and sub-county Environmental Strategy Planning:	
Tool 1. Baseline establishment: Inventory of Natural Resource Inventory & Environmental Hazards (Xichang County)	What, Where, When
Tool 2. Resource Suitability & Depletability Analysis (Qionghai Lake & Luojishan Nature Area)	Which, Where, How
Tool 3. Resource Use and Stakeholder Analysis (Qionghai Lake)	Who, What
Tool 4. Socio-economic Analysis at Community and Household Levels, (Upstream and Downstream Villages)	Who, What, Why, How
Tool 5. Pressure-State-Response and Problem Tree Analysis (Qionghai Lake & Related Sub-watersheds)	Why, What, Who
Group II. Development Facilitation:	
Tool 6. Conflict-Complementarity and Policy Tradeoffs Analysis of Stakeholders, Qionhhai Lake	Who, How
Tool 7. Resource-Power-Influence Analysis of Stakeholders, Qionghai Lake	Who, What
Tool 8. SWOT (Strengths, weaknesses, opportunities, and threats) Analysis of Qionghai Lake Management Bureau	What, Why

[2] Project planning activities are often linked to county strategies, and may be "nested" within the latter.

Exhibit 1. Summary of Contextual Information on Xichang

Item	Description
Location	400 km southwest of Chengdu, 27° and 28° N and around 102° E.
Area	2655 km^2, including Qionghai Lake 28.82 km^2.
Demography	Population 530,000, of Han Chinese and Yi and other ethnic groups (18%), living in 5 urban administrative districts, 7 towns & 29 townships, with 232 villages; 12 townships solely or predominantly Yi minority.
Climate	Subtropical to cold and warm temperate; influenced by landforms & altitude; high insolation (>2400 hrs); annual rainfall 1013mm (intense summer rains, 60% during May - Aug); average annual teperature said to be 17° with Jan 9.5° & July 22.6° and 272 frost free days (data needs careful interpretation due to altitude factor).
Physiography/ Soils	Four regions may be discerned: 1) Anning Valley, Qionghai Lake Basin; 3) Western Mountainous zone; and 4) Eastern (north and south) mountainous zone. Elevation from around 1500m to > 4000m (50+ peaks). Hills and mountains occupy 80% of area. Glacial features at higher elevations include cirques, lakes, moraines boulder clay; hillsides, valley walls often unstable and predisposed to landslides, land collapse. Geology of quaternary period, with seven soil groups: 1) paddy soils (11.6%); fluvial deposits (1.0%), purple soils (11.1%), red soils (29.7%), yellow brown soils at 2400 - 2700m (18.0%), brown soils above 2700m (12.4%), & "sub-alpine" soils (18.2%).
Rivers & lakes	Main river Anning (catchment 1676 km^2, annual flow 3,562m cu m), with 20 main tributories of which 4 with subwatershed >100 km^2; Yalong river western boundary; Qionghai lake 28.82 km^2 and 300m cu; 5 hotsprings; >10 sites with hydro-power potential >100Mw.
Agro-climate Zones	Falls within Sichuan's "Southwest Mountainous Sub-tropical Agricultural, Forestry, Livestock Agro-climatic Zone"; nominally under Xichang-Huili paddy-wheat two season subzone, but influence of landforms and altitude variations mean some areas more akin to Daliangshan mountainous temperate forestry, livestock and agriculture subzone (as in Xide and Puge counties).
Agricultural Zones	Divided into three "Integrated Agricultural Planning Zones", namely: 1) Anning-Valley-Qionghai Lake grain,vegetables, fish, pigs, fruit & tobacco; 2) Maoniushan (Yak mountain) & Mpoanshan forestry, livestock & crops; and 3) Luojishan & Beishan (north mountain) forest, livestock, crops & tourism zones. The livestock bureau has its own planning zone demarcations (Anning Valley pig, poultry, milch cattle & buffalo zone & Western Plateau and mountains yak, goats/ sheep & cattle zone).
Present Landuse	Of 2655 km^2: 58.6% forestland, 19.4% cultivated (51.2% paddyland/ 48.8% dryland), 1.5% orchards, 6.0% pastureland, 4.3% water bodies, 6.6% wasteland; settlements/ mining, industry & infrastructure 3.5% (1993 data based on remote sensing). Sectoral/ statistics bureau data based on annual village reports generally underestimate cultivation extent. There had been much wasteland conversion to agricultural & other uses over the past 15 years (currently only 7020 ha wasteland remaining, compared to 17,600 ha in 1993, and 34,000 ha in 1982).

(contd.)

Flora & Fauna	Variations in altitude have meant a range of natural vegetation, from sub-tropical forest species (to conifers, evergreen broadleafs, and montane conifers. Important ecosystems are found in the high mountains and in lakes and rivers, especially Luojishan nature area and Qionghai Lake. In Luojishan are found many species of flowering and non-flowering plants, including rhododedrons, camellias, azaleas, rough gentians, lilies and winter jasmine (30 species are listed under state protection), in addition to many types of medicinal plants, ferns and edible wild mushrooms. There are also a wide variety of wildlife, including 60 types of mammals, over 250 types of birds, and various reptiles and amphibians (among those listed under state protection are the lesser panda, stump-tail monkey, forest musk deer, gorals and pangolins). In Qionghai Lake and the rivers of Xichang, including the Anning River, are to be found many different aquatic species, including edible water plants, fish, and freshwater shrimp. Some 70 fish species (falling under the suborders Cyriniformes, Ciluriformes, Cyprinodoniformes and Symbanchiformes) have been listed. The Cyriniformes, which include the carp families Cyprinidae and Cobitidae are by far the most numerous, making up over 50 of the species listed. Some species (e.g. "Xichang Baiyue" or Anabarilus liui Chang and "Qionghai Baiyue" A. qionhaiensis) come under the provincial protected list.
Minerals	Rich deposits of rare earth minerals, tellurium, vanadium-titanium magnetite, besides iron ore in the city and nearby counties. Bureau of Mines at various levels have survey data on quantities and locations, but such data are generally departmental secrets.
Farming systems	Lowland areas in Anning Valley and around qionghai Lake: rice-wheat system with other food and cash crops (tobacco, broad bean, soya bean) in rotation or as intercrops; pigs and small number of draft oxen, buffalo. Fruit orchards (pear, peach, pomegranate, apple) largely on former wasteland, but maize and tobacco also observed on latter. Mulberry & silk production is on the increase in recent years. Some lakeside farmers also carry out artisanal fishing, shrimping, and fish pond farming. Large scale commercial stocking & harvesting (10 boats) of exotic silver fish (yinyue), lobster, crab in lake. Highland areas: above around 2000m, buckwheat, oats, barley, potato, with wild pepper (Xanthoxylum bungeanum Maxim) as valuable tree crop; livestock important and include sheep, goats, cattle, and pigs, generally under free range.
Economy	Agriculture mainstay of population, but secondary & tertiary sectors have grown in importance to 29% & 46% of GDP. Economic growth 14.7% per year during 1991 - 96 and 8.8% throughout 1980s. Tourism an important industry, with 17,000 hotel beds & 350 tourist restaurants, & 18.6m visitor-transactions/ yr. in 1997. Per capita income in 1997 of 1860 yuan; but distribution uneven, with pockets of poverty especially in highland areas (with township average per capita incomes of 1000 yuan). (contd.)

Development Strategies & Projects	Long term social and economic perspective plan to year 2010 prepared; multi-pronged development from natural resource & technology based development, including tourism, commerce & trade expansion. Industrial structure to shift to construction and metallurgy, away from food processing, chemicals, & light industries. Planned GDP growth of 10.6% - 11.1% till year 2010. Planning Commission has listed 58 investment projects for funding under 9th FYP, including 21 for agriculture (livestock, commercial aquaculture, horticulture, cut flowers), & 6 for tourism. World Bank funded Anning Valley Project will assist with components for food grain, duck, rabbit, mulberry/ silk, & fruit production.
Resource Degradation & Environmental Pollution	Over 40% of Xichang subject to erosion & nearly 23% under severe to violent erosion (1987 data). Sedimentation & debris flow of rivers & lake: Anning river affected by high sediment load from Xide county, at confluence with Shensuihe near Lugu town; Qionghai lake area and depth decreasing (annually by 0.3% & 0.75m, respectively) duc to sediment/ debris flow from Guanba & Erjang rivers (currently 500,000 tons/year from both rivers). Erjang ceased being perennial river from early 1980s. Eutrophication of Qionghai lake during 1980s & early 1990s from high levels of N & P, ascribed to fish cage farming in lake, over-the-water restaurants & surface runoff from agriculture & wastewater from around 1000 lakeside resident households. Fish stocks declining, while water hyacinth (Eichhornia crassipes Mart, Solmes.) on lake surface now a weed problem. Anning river dowstream of Haihe polluted by Xichang urban wastewater.
Government Responses	Prefecture & city governments undertook various legislative, administrative, and regulatory/ enforcement measures to address Qionghai Lake degradation issues. Qionghai Lake Management Bureau (QHMB) established in 1994 empowered to protect lake environment, including subwatersheds of Erjang & Guanba river up to boundary with Zhaozue county. QHMB responsible for control/ and regulation of fishing, industrial, and tourism related activities. Apparent water quality improvement since 1995 (BOD down from 0.91 to 0.68 mg/l; total N down from .52 to .22 mg/l; & P down from .15 to .02 mg/l). Various environmental enhancement projects also identified covering wastewater system, afforestration, economic forestry, debris flow control structures, and city garbage disposal & treatment.
Community Responses	Land degradation affects both lowland & highland communities. Lowland households affected by floods/ debris flow contribute labour and cash/ kind to build & strengthen levees (preventative costs) and to rehabiliate areas damaged from time to time. Loss of irrigation water from rivers drying up compensated by pumping from lake. Highland communities often lose arable and residential land through gullying, soil erosion and land slumping/ debris flow. They appear to have own strategies to tackle these e.g. by planting local trees/ shrubs (e.g. local names Beyang, Jimu, and Gerba) to stabilise steep slopes & gullies; fallowing of plots & crop rotation to maintain fertility, organic matter, some plots left uncropped when rainfall appears too intense & conditions deemed hazardous for planting. Trees are often planted as a "saving" towards future cremation requirements. (Much more work is however needed to understand in depth the community & farm household economic & socio-cultural goals & strategies).

Exhibit 2. Local Government Environmental Responsibilities for Management of Qionghai Lake and Measures Taken Todate

In accordance with prefecture and city governments' "Qionghai Lake Protection Regulations" of 1997, the Qionghai lake Management Bureau (QLMB) was given the responsibility for protection and integrated management of:

a) Qionghai Lakes's waterbody;

b) its immediate shoreline up to 200m inland;

c) Erjang subwatershed (falling entirely within Xichang county); and

d) the portion of Guanba subwatershed that falls within Xichang county (the portion under Zhaozue county, by definition, being excluded).

Within the protected zone, QLMB has control over fisheries and tourism activities, building construction, water resource quality, and protection of wildlife/ aquatic plants and forestry trees. Measures instituted since QLMB was established include:

* Banning of fish cage culture in the lake, along with licensing of fishing boats, line fishing, and shrimp fishing (licenses are issued to individuals from only seven villages, with a 2-month open season for fishing boats);

* Strict control on lakeside development, including compulsory relocation of the 'over the water' restaurants inland, and closure of offending restaurants;

* Mandatory installation of water treatment for the battery factory; and closure of the fertiliser factory;

* Tree planting along the 200m wide strip of shoreline; and

* Restricting the use of motorised boat traffic; all tourist boats are now battery or manually operated.

Exhibit 3 indicates the checklist of bio-physical and socio-economic information on Xichang city submitted to various local government agencies prior to the field visit to the county. A checklist of institutional items was similarly prepared, and formed the basis of discusssions with local officials, including the Qionghai Lake Management Bureau,[3] which had recently been set up with overall responsibilities for environmental protection of this resource.

Exhibit 3. Checklist of Bio-physical and Socio-economic Information Items to be Collected on Xichang City

Main Items	Sub-items
Physiography and agro-ecology	Land forms, geology, main rivers/ lakes, altitude ranges, physiographic regions, agro-ecological zones/ agricultural planning zones.
Climate	Sunshine hours/ intensity, rainfall pattern & temperature regime (by months/ years/ zones), accumulated temperatures above 5° and 10°.
Soils and natural vegetation	Main types, characteristics, usage, soil fertility status, zonal distribution.
Flora and fauna	Ecological systems, forest species, incld. non timber forest species, unique & protected wildlife & aquatic species within area, biodiversity aspects; special attention Qionghai Lake and Luojishan nature reserve.
Water resources	Ground and surface water, quantities and quality of main sources, lake & river sedimentation/ silt load, pollution extent, distribution over years/ months/ seasons; hydro-electricity generation and potentials.
Mineral resources	Quantities and qualities of deposits, present level of exploitation, practices used, by sub-regions.
Tourism resources	Scenic, recreational, historical, cultural, scientific sites, current usage, tourism facilities, tourist flow, sources, transactions, and trends.
Environmental degradation/ natural disasters	Occurence of floods, droughts, debris flow, mudslides, soil erosion, hailstones, wind and insect damage (qualitative and quantitative data), and earthquakes.
Pollution	Air/ water pollution indicators, main pollution sources, current situation and trends, strategies by government and communities to address problems, actions taken.
Demography/ settlements	Human settlements, total and rural population, number of households, ethnic groupings, distribution (by townships/ physiographic regions), population density, growth rate.
Social & economic indicators	Gross Domestic Product, distribution by sectors (agriculture and livestock, mining, industry, primary, secondary, tertiary), major state enterprises, town and village enterprises, average household incomes, poverty regions; incidence of poverty households, state assisted "distress & five-guarantee" households, literacy rates by regions; preliminary information on farm household types.

(contd.)

[3] Checklist items included: current local legislation for environmental protection; organisation, authority/ power and enforcement; personnel/ staff strength & capacity; type and nature of plans; development budgets, revenue & expenditures; inter-sectoral relationships, cooperation & coordination mechanisms; composition of government "leading groups", frequency & effectiveness of meetings; extent of community participation.

Land use	Area extent (% distribution) of agriculture (irrigated & rainfed crops), orchards, forestland (various categories), pastures, wasteland, water bodies, etc. (based on State system of classification, Territorial Bureau and sectoral sources); check area trends, incld. wasteland conversion for agriculture/ orchards & other uses.
Agriculture & food production	Area of food crops & economic crops, production levels, average yields, livestock types, numbers & annual offtake/ sales, freshwater fisheries (lake, rivers, pond production), sectoral production targets, trends, with special attention on crops like tobacco.
Land tenure/ management typology	Household responsibility & other systems of land tenure/ management & of user rights, individual households, collective/ cooperative/ commercial organisations, state operated, & others (various uses and types of arrangements).
Development strategies & projects	Area development strategies (long & medium term, sectors), 9th FYP, existing, approved/ pipeline development projects, proposal/ project ideas (includ. sectoral, environmental protection proposals); World Bank Anning Valley Project details.

Table 1. Analytical Results of Tool 1 - Natural Resource Inventory and Hazards, Xichang City: Summary

Resource or Hazard	General Description
A) <u>Renewable resources</u>:	
1. Sunshine and precipitation	Sunshine >2400 hrs per year; annual rainfall 1013mm (but lowest recorded of 691mm in 1962, and highest of 1471mm in 1968), mainly night rains (intense summer rains, 60% during May - Aug); average annual temperature said to be 17°, with mean Jan 9.5° & July 22.6° and 272 frost free days. These data may understate more extreme temperatures at higher altitudes.
2. Arable land *	51,630 ha of which 63% in flat areas, 37% in mountainous areas. Around 83% of latter is of medium to low productivity (grain yields below 100 kg/ha). Around 38% of flat land is of high productivity (grain yields 400 kg/ mu or more). Land suitability/ land quality data not available. Note that much wasteland has been converted to agricultural & other uses over past 15 years (currently only 7020 ha wasteland remaining, compared to 17,600 ha in 1993, and 34,000 ha in 1982).
3. Soils	7 main groups: 1) paddy soils (11.6%); fluvial deposits (1.0%), purple soils (11.1%), red soils (29.7%), yellow brown soils at 2400 - 2700m (18.0%), & brown soils above 2700m (12.4%), sub-alpine soils (18.2%). Subdivided into 13 sub-groups, 18 families, 80 types (series?).
4. Water	a) Main river Anning (catchment 1676 km^2, annual flow 3,562m cu m), with 20 main tributories of which 4 with subwatershed >100 km^2; b) Yalong river western boundary, with 2 rivers >100 km^2 ; c) Qionghai lake 28.82 km^2 and 300m cu m; d) 5 hotsprings sites; e) More than 10 sites with hydro-power potential >100 MW.
5. Forests	Primary & secondary (including aerial seeded) forests, which together with bushland, sparse woodlands & immature trees total 155,590 ha (58.6% of total area of Xichang). Trees species range from sub-tropical forest species (to conifers, evergreen broadleafs, and montane conifers. Forestry bureau has extensive list of indigenous and exotic species endemic or introduced (e.g. Pinus, Eucalyptus) into different locations. (Not clear if quantitative data available). Local people also have knowledge of wide range of trees and shrubs, used for fuel, timber, gully protection, and as condiments (e.g. local names like Ji-mu, Be-yang, and assorted forests species of "jah-mu"). There was insufficient information to correlate with scientific names. (contd.)

6. Flora & fauna (biodiversity)	Natural: Important ecosystems are found in the high mountains and in lakes and rivers, especially: a) Luojishan nature area, in addition to many varieties of forest trees, contain many species of flowering and non-flowering plants, including rhododedrons, camellias, azaleas, rough gentians, lilies and winter jasmine (30 species are listed under state protection), in addition to many types of medicinal plants, ferns and edible wild mushrooms. Wildlife include 60 types of mammals, over 250 types of birds, and various reptiles and amphibians (among those listed under state protection are the lesser panda, stump-tail monkey, forest musk deer, gorals and pangolins). b) Qionghai Lake and the rivers of Xichang, including the Anning River, contain many different aquatic species, including edible water plants, fish, and freshwater shrimp. Some 70 fish species (falling under the suborders Cyriniformes, Ciluriformes, Cyprinodoniformes and Symbanchiformes) have been listed. The Cyriniformes, which include the carp families Cyprinidae and Cobitidae are by far the most numerous, making up over 50 of the species listed. Some species (e.g. "Xichang Baiyue" or Anabanlus hui Chang and "Qionghai Baiyue" A. qionhaiensis) come under the provincial protected list. Agricultural: Local varieties of soya bean and broad bean ("Dabu Fudo"), peach variety ("Huangxin Tao"); indigenous Jenchang duck (much in demand for processing/ wind drying); Jenchang pony (prowess for hill climbing).
B) Non renewable*	
Minerals/ fossil fuels	Rich deposits of rare earth minerals, tellurium, vanadium-titanium magnetite, besides iron ore in the city and nearby counties. (Quantity & locations secret). No known deposits of petroleum or coal.
Scenic, historical, cultural, scientific sites	Qionghai lake scenic area; Lushan mountain; Huanglianguan rock sulptures; Luojishan nature area multi-coloured lakes, waterfalls, primary forest vegetation, also Tang dynasty buddhist sites; quaternary geology & biodiversity of Luojishan are a living museum.
C) Main hazards (existing & potential)	
	a) Natural: Some landforms in Xichang are fragile, as its geological history predisposes Xichang to soil erosion (especially Guanba river), landslides on hillslopes and debris flow along valleys (especially Erjang river). This is exacerbated by the intense summer rains (60% falling between June & August, as much as 100 mm/day (highest recorded was 135.7 mm in a day in Aug 1951). Xichang lies on southern extension of Xianshuihe fault system (Anninghe and Xiaojiang faults) hence prone to earthquakes (6 ocassions of magnitude ~ Richter 6.5 since 1920s). b) Human induced: lakeside commercial & domestic wastewater discharge in Qionghai Lake; Xichang urban wastewater discharge into Haihe, thence Anninghe; fish cage farming in Qionghai lake (ceased from 1995) & surface runoff of agricultural fertilisers into Qionghai lake; water hyacinth Eichhornia crassipes growth on lake surface; conversion of wasteland on hill slopes around Qionghai Lake for crops, especially maize & tobacco; introduction of exotic species (crabs, crayfish, "yinyue" silverfish Neosalanx taihuensis, carps) & fine-mesh net harvesting of "yinyue" in Qionghai Lake; overstocking of ruminants livestock; mining & industrial effluent into river system; farming on hillslopes overlooking lake & in highlands, some > 25°; tourism development in vicinity of pristine nature areas in Luojishan.

* The term "arable land" is used somewhat loosely here, as wasteland is sometimes converted to arable use, while there had been conversion of arable land for industrial and urban uses. The present cultivated land is expected to remain relatively constant in the near and distant future, hence may be a proxy for arable land.

Table 2a. Analytical Results of Tool 2 (Part 1) - Resource Depletability Analysis, Selected Examples from Xichang

Natural Resource	Depletability Status (Yes?)			If conditional renewable: natural processes involved & management systems needed:
	Non renewable & non recyclable	Renewable & non-conditional	Conditional renewable	
Earth Minerals	Yes			
Solar Energy		Yes		
Qionghai Lake:				
- Wasteland/ dryland soils in hills around lake			Yes	Soils planted to annual crops (maize, tobacco) on slopes over 30% (16°) generally subject to soil erosion. Continuous cropping & use of chemical fertilisers can degrade soil physically & chemically, & lead to P & K runoff into Qionghai Lake. Conversion of wasteland to crop needs careful monitoring. Use of conservation farming systems, including inter-cropping, rotations, grass strips/ hedge barriers & terracing need to be considered.
- Natural fish/ shrimp species			Yes	Complex aquatic ecology, with different food chains and subzones within lake (e.g. top/ bottom feeding, breeding areas). Offtake of local carp (Cyprinidae) species "bailian" & "hualian" & shrimp from lake may be subject to increasing pressures from commercial stocking of "yinyuc" silverfish & crabs & crayfish, methods of which require careful review. Despite legislation, national protected Anabarilius species (Xichang & Qionghai "baiyuc") find their way to the market. Enforcement efforts need to be supplemented by better information to local people. Ecological studies of species dynamics also required.
Luojishan Nature Area:				
- Scenic landscape			Yes	Multi-coloured lakes, thermal waterfalls, geological sculptures are renewable only if not physically and visually damaged by commercial developments & human usage. To preserve pristine nature of key sites i.e. not lost to future generations, strict enforcement of infrastructure and building construction guidelines & recreational usage is vital.
- Natural flora & fauna			Yes	Complex forest ecology with many "niches" for different species, impossible to reproduce through human planting. Commercial exploitation to be prohibited, but low pressure indigenous people harvesting & gathering (e.g. medicinal herbs, mushrooms, wild honey) is often sustainable due to practices & knowledge over many generations.

Table 2b. Analytical Results of Tool 2 (Part 2) - Resource Suitability Analysis (Selected Examples)

Natural Resource Category	Usage	Order of Suitability	Limiting Characteristics & conditions of use *	Opportunities for enhancing suitability *
Qionghai Lake:				
Wasteland/ dryland soils in hills around lake	Food crops/ tobacco production	Medium	Only on slopes < 16° (30% slope), to minimise erosion risk; use of grass strips/ hedge barrier or terracing may be necessary, depending on soil erodibility; good ground cover & high organic matter needed to prevent soil degradation	Use of conservation farming practices, including agro-forestry to increase ground cover, provide green manure/organic matter & enhance fertility
	Fruit orchards	High	Only on slopes < 25° (45% slopes), but terracing is generally necessary; soil depth must be adequate for tree root zone	Legumes & grass species introduced to improve ground cover & provide green manure; farmers trained to build & maintain terraces, to good standard
Water body of lake	Commercial stocking & harvesting of aquatic species	Medium	Aquatic eco-system should not be upset by exotic species; natural biodiversity to be safeguarded; hence species selection & harvesting methods require careful review.	Reduce N & P inflow to lake, minimise backflow from Haihe river
	Boating & water sports	Low	Only wind, battery & human powered; no motorised boats.	
Beachfront scenic area	Hotels	Medium	Minimum 40m from water edge, no high rise, own wastewater treatment installation	Suitable trees & ornamental plants strategically placed
	Industrial park	Low	Minimum 80m from water wedge, no chemicals & wastewater discharge to lake; air or noise pollution within permissible limits (e.g. 50 dBA by day & 40 dBA by night)	As above, plus proper access roads & wastewater disposal system
Luojishan Nature & Scenic Area:				
Outside nature reserve	Holiday village (intensive use area)	Medium	To be outside buffer zone bordering nature reserve area; constructions should keep aesthetics in mind/ not be visually obtrusive; list of permissible activities to be drawn up & strictly enforced (including noise levels e.g < 40 dBA)	Zoning study to identify sensitive/ fragile areas & extent of buffer zone required; thorough consultations with local inhabitants (around 1000)
Within nature reserve (1000 km^2)	Eco-walks, scientific studies (extensive & restricted use area)	High	Requires buffer zone separating nature area from above; no motor vehicles, low volume hiking only; all applicants for visit to be carefully vetted & tours supervised	As above

* For illustration only. Local planners may insert other limitations and conditions in accordance with national, provincial or local guidelines; opportunities may similarly be indicated.

Table 3. Analytical Results of Tool 3 - Resource Use and Stakeholder Analysis, Qionghai Lake

Type of Use	Extent of Use	Primary Stakeholder (those affected)	Secondary Stakeholders (those affecting):
Domestic Water Supply	Xichang urban centre, including lakeside towns and townships: 195,000 people approximately	Xichang urban residents City water company	
Irrigated rice farms	Pumping to 14,000 mu of rice farms around lake	Paddy farmers in Hainan, Chuanxin, Gaojian & Xijao townships	a) Within Xichang County: QLMB (Qionghai Lake Management Bureau) *
Dryland farmers	Crops on village allocated dryland plots & converted wastelands/ pastureland/ forest land	Farmers in hills around lake, especially Daxin township Upstream farmers of Erjang & Guanba subwatersheds (Xichang & Zhaozue)	Environmental Protection Bureau Xichang Planning Commission/Finance Bureau Forestry Bureau
Licensed Artisanal Fishing	800 boats (2 month season/ year) 300 line fishermen (year round) 200 shrimp fishermen (year round, restricted hours per day)	Farm households with boats & license Individuals with licenses Farm households with licenses	Agricultural Bureau Tobacco Development Office Xichang Tourism Office Territorial Bureau
Commercial Fish Stocking/ Harvesting	10 boats open water harvesting of Yinyue silverfish (no quantitative data) Stocking/ harvesting of crayfish and crab (no quantitative data)	Private commercial company Private joint venture company	Soil & Water Conservation Office b) Outside Xichang County:
Tourism	18.6 million visitor-transactions in 1997, including hotels (17,000 beds), shops, restaurants (350), transportion & entertainment.	Tourists from within & outside Sichuan Lakeside restaurant/ hotel owners	Various county & township government departments, Zhaojue county (including Hongxin township)
Human Settlement	Residential houses at immediate shoreline of lake	Residents in Hainan, Chuanxin, Gaojian & Xijao townships	

* Under the Regulations (Local Legislation) for Qionghai Lake Environmental Protection, passed by the city and prefecture governments, functions and responsibilities of the following government agencies have been transferred to QLMB: Horticulture and Aquatic Products Bureau; Traffic Office (boats); Forestry Bureau (within 200m of shoreline, and the area under the Erjang and Guanba watersheds). Along with this was their relinquishing of revenue collection (licenses, fees) to the QLMB.

Table 4a. Analytical Results of Tool 4 (Part 1) - Socio-economic Circumstances of Local Communities: Upstream and Downstream Villages

Item	Downstream Community: Hetao & Zhongluo Villages	Upstream Community: Shengli Village (Wojuba hamlet)
I. General Township Information:		
Township	Hainan township (with 4 villages in all)	Daqing township (with 3 villages in all)
Population	5826	3719
Altitude (asl)	1510m - 1560m	2000 - 2500m
Cultivated land	0.84 mu/ capita	2.17 mu/ capita
Fishing Activities	Around 80 fishing boats; approx. 180 households involved in fishing, including shrimping; also 700 mu fishponds (various carps)	No fishing
Income/ capita (1997)	1830 yuan on average	1193 yuan on average
Ethnic groups	Han Chinese (93.3%), Hui muslim (5.7%) & others (1.0%)	Mainly Yi minority (98.8%).
II. Village & Farm Household System Information (Preliminary):		
Land resource & utilisation	Cultivated land between 0.8 - 1.0 mu mu/ capita; mostly paddyland, with up to 10% dryland; around 90% of paddyland used for grain, remainder for intensive vegetables & oilseed; wasteland converted for orchards (plum, peach, pear) & maize (300 mu converted in Hetao since 1990). There is no pastureland, & some livestock grazing is in state forestry areas.	Around 3 - 4 mu/ capita; includes low quality land, some converted from pastureland, wasteland, & forestland allocated to households; all dryland crops & no irrigation; crop-fallow practised, but fallow periods decreasing, now as short as one year. Animals grazed on crop residues, fallow land, wasteland & hill slopes.
Crops & farming system	Generally a) Wheat-rice rotation, wheat intercropped with broad bean (soya bean also grown); rice irrigated by pumping from Qionghai lake; b) Maize on dryland areas & on wasteland; c) Diversified production of vegetables (cabbage, chillies, garlic), oilseeds & tobacco, on portion of paddyland; c) Orchards of peach, plum, persimmons, & pear.	Main summer crops of buckwheat (subsistence), potato (home consumption, pig feed & for market), with smaller quantities of oat & barley; winter crops only of radish. With decreasing fallow, maintaing soil fertility appears to be now a problems. Sichuan pepper trees (prickly ash or Xanthoxylum bungeanum Maxim) are grown as cash crop.
Livestock	Pigs (mostly for fattening/ finishing), kept in pig pens), poultry, including ducks & geese; few sheep; some buffalo kept for ploughing.	Pigs (home consumption & sale as piglets), goats, & sheep kept; adult sows mainly under free range, but some households beginning to build housing for pigs & goats/ sheep; some chicken, few cattle also kept; pig swill cooked for piglets.

(contd.)

Fishing	Some (< 10%) farm households also in artisanal fishing & shrimping. Fish caught include: "Baiyue, Qingyue, Hongyen, Lenyue, Betiao, Wuyue" mainly carp species.	Not applicable
Aquatic plants harvested	"Lianjao" (Trapa natans var. bispinosa) & edible "Bienjacai" collected from lake; "Haicai", & "Jachao" no longer available since early 1990s.	Not applicable
Trees	Few trees within village, but 1500 mu of village collective forest in Hetao (planted to Pinus Yunnanensis pine), timber species. Harvesting is subject to forestry law (no felling unless equivalent amount planted).	Many households have small fenced woodlots (mainly of "Beyang & Jimu"); as saving for use in cremation. But unclear user rights in view of forestry law, and hesitancy in tree planting on hill slopes near village.
Fuel supply	Some households purchase coal, but most use fuelwood: mainly branches, underbrush, leaf litter, collected from protection forestry areas of hills around lake.	No coal bought; fuelwood cut or collected from local shrubs & bushes ("ja-mu"), saplings, dead branches, from around village & also from state forestry farm (mainly pine) 4 km away. Collected by women household members.
Household types	Production of subsistence & "duty" (tax & compulsory sale) rice & wheat, by all households, plus various other crops or livestock. Many have poultry & some non-farm income sources; a few are in trading/ business, while some households also fish. Subcategories of households by economic activity are: 1) Subsistence & duty wheat & rice with pig fattening; 2) As in 1) plus intensive vegetables; 3) As in 2) plus fruit orchards (usually plum & peach; 4) As in 1) plus fishing; and 5) As in 1) except only goats kept, with no pigs. Some economic differentiation in village, with specialised households emerging, but not very pronounced. In general better off households with wasteland invest in pear (5 years to production), while poorer households invest in plum or peach (3 years to production), while poorest households only plant maize on wasteland.	All households have subsistence buckwheat, potato, & oats, with Sichuan pepper as cash crop; pigs, sheep/ goats common to all households. Very little off-farm employment income. Little economic differentiation within village.
Main problems & constraints *	Bio-physical: Debris flow from Erjang topping levees & destroying surrounding farmland (3000 mu affected, with 300 mu destroyed in 1996); height of riverbed increasing & levees need repairs & building up yearly; since 1984, river no longer perennial & unuseable for irrigation, hence pumping from Qionghai Lake necessary.	Bio-physical: Soil Erosion, gully formation & land collapse during intense summer rains lead to loss of cropland & residential land in village; effective means of stabilising gullies not available (lack planting materials; forestry species such as Yunnan pine, though fast growing found not suitable in village situation) (contd.)

	Socio-economic: Land shortage a major production constraint; for fishing households, catch now much smaller & fewer varieties than ten years ago. Funds shortage affect choice of investment on paddyland, dryland & wasteland.	Socio-economic: Land productivity low & some households have grain shortage; converting pastureland to crops has led to livestock feed problems; some households have labour shortage (poverty households with only aged members); most have difficulty getting off-farm income; most have limited knowledge of Chinese language & few with even full primary education; relatively high cost of education (350 yuan/ year per child) outside village
Possible household goals & strategies *	a) Agricultural production: to meet needs for 1) subsistence & 2) household "duty" commitments of "Zenggo & Denggo" (tax in kind & mandatory sales to state); & for cash income. b) Debris flow problem tackled by households contribution in kind & labour to annual repairs & maintenance of levees. c) Some poaching of fish outside license arrangements to supplement incomes likely.	a) Crop production to meet subsistence needs, for livestock feed, & for cash income (agricultural tax is at fixed rate, now at 8 yuan per mu); small individual woodlots mainly as saving for cremation needs; b) Soil erosion & gullying tackled by planting local trees/ bushes e.g. "Beyang", "Jimu", & "Gerba" (local name), but lack suitable planting material & propagation methods; c) Plots on more fragile slopes left uncropped when rains thought to be too intense during season; d) Soil fertility replenishment by crop-fallow system; some households beginning to keep animals in shed & collect manure for crops (mixed with pine twigs & shrubs). e) Some better off households have migrated to other areas.

* Preliminary impressions only, will require further investigation.

Table 4b. Analytical results of Tool 4 (Part 2) - Historical Timelines for Two Communities in Erjang Subwatershed *

Shengli Village (Upstream Yi Community)		Hetao/ Zhongluo Villages: (Downstream Han Community)	
Year		Year	
1954	Collectivisation of agriculture begins; little cropland, mainly pastures & "wasteland" in village		
1964	Collective village feeding, households required to harvest fuelwood from natural forests		
		1968	Qionghai Lake flooding of village
		1970	Qionghai Lake flooding of village
1980	Households allocated individual plots; grain deficit in many households		
		1981	Pumping station constructed, guaranteed irrigation
1982	Pastureland & forests conversion to crops accelerate		
		1984	Erjang river no longer perennial flow; dry from Feb - June; no irrigation possible
1995	Major earthquake		
(recent years)	Fallow period shortening; Loss of farm plots through soil erosion; Some households have migrated from village	1996	Major flood & debris affected 3000 mu and destroyed 300 mu of paddy in Zhongluo (left bank)
1998	Severe erosion, gullying & land collapse	1998	Right bank levee of Erjang breached in August **

* Based on recollection of local residents; will require further corroboration.
** Information received by telephone from Xichang.

Table 5. Analytical results of Tool 5 - Pressure-State Table -Response Framework: Examples from Qionghao Lake

Environmental Issue or Problem	Pressure	State	Response
Deteriorating Water quality of Qionghai Lake	Commercial, residential & fish farming activity: a) Over the water restaurants, lakeside hotels & restaurants wastewater discharge; b) Around 1000 lakeside households wastewater discharge; c) Feedstuffs used in open water fish cage culture	Eutrophication of lake; by mid 1990s, lake water quality indicators were below National Standard Class 2 for domestic water supply, but trend recently reversed	a) Prefecture Peoples' Consultative C'ttee commissioned survey of environmental problems (1993); b) Prefecture & city governments legislative action (1997 Regulations); c) Establishing Qionghai Lake Management Bureau (1995); d) Establishing Prefecture & City level Leading Groups for coordination of Qionghai Lake Protection e) Strict enforcement of regulations by Environmental Protection Agency (including closure of restaurants & factories)
Qionghai Lake Sedimentation & Debris Flow	a) Conversion of wasteland/ hills for crops around lake and in Guanba & Erjang subwatersheds, leading to soil erosion b) Natural geology predisposing factors & Debris flow on Erjang River	a) Lake area decreasing by 0.3% per year; land encroachment at Guanba river mouth 5 - 10 m/year b) Depth declining by 0.75 m per year c) Debris flow & sediments into Qionghai lake 500,000 tons per year d) Floods & debris flow destroy farmland in villages of Hainan township (300 mu in 1996)	Farmers contribute labour each year for repairs & improvements to levees an both banks of river; there is also collective forestry planting on hills overlooking Hetao village, and planting of fruit trees by farmers on wasteland around lake, but rights of tree harvest and relative profitabilty of fruit growing could affect future activities
Invasion of lake by exotic species	a) Local farmers introducing new plants into streams and ponds in Xichang	Water hyacinth expanding over lake area (no quantitative data)	City government pay for manual removal from fishing boats (100,000 yuan budgeted for 1998), but no other actions.
	b) Commercial companies stocking lake with exotic fish, crab, crayfish	(Possibility of) fish ecological balance affected, loss of biodiversity (negatively or positively, but no clear data) *	No apparent perception of potential hazards by governmental agencies
Loss of Cropland from Erosion by Upstream Communities	a) Hill slope cropping by farmers without conservation practices b) Farmers' practice of diverting streams for village & home use, along with natural geology & rainfall conditions lead to gully formation	Crop plots (& sometimes house plots) lost from sheet erosion and land slumping	Farmers attempt to stabilise gullies with local trees ("Baiyang, Jimu") and leaving crop plots fallow whenever rainfall deemed hazardous in a given season; better off farmers may migrate to other areas.

* There is inadequate information on this aspect. However, artisanal fishermen suggest local fish population may be affected negatively (fish size and number of fish species) by the fine-net fishing methods used for "yinyue" silverfish (Neosalanx taihuensis) introduced into the lake by the commercial company.

Table 6a. Analytical results of Tool 6 (Part 1) - Conflict-Complementarity Matrix, Qionghai Lake

Stakeholders	Urban residents	Lakeside paddy farmers	Farmers in hills around lake	Upstream farmers in two subwatersheds	Artisanal fishing households	Commercial "silverfish" silverfish company	Crayfish & crab Joint venture company	Lakeside Restaurants	Qionghai Lake Management Bureau	Other government agencies *
Urban residents										
Lakeside paddy farmers	OO									
Farmers in hills around lake	OO	CM								
Upstream farmers in two subwatersheds	OO	CX	OO							
Artisanal fishing households	CM	CM	OO	OO						
Commercial "silverfish" company	CM	OO	OO	OO	CX					
Crayfish & crab Joint venture company	CM	CX	OO	OO	CX	CX				
Lakeside Restaurants	CM	OO	OO	OO	CM	CM	CM			
Qionghai Lake Management Bureau	CM	CM	CX	CX	CM	UC	UC	CX		
Other government agencies *	CM	CM	CM	UC	OO	CM	CM	CX	CX	

(Possible relationships: CX = conflicts of interest; CM = complementary; OO = no apparent relationship; UC = unclear as yet).

* Refer to Tool 5 for information on various government agencies, also secondary stakeholders.

Table 6b. Analytical results of Tool 6 (Part 2) - Possible Outline for Policy Tradeoff Matrix, Qionghai Lake

POLICY DECISION OR ADMINISTRATIVE ACTION	Development Objective or Antlelpated Impaet (Incremental Change) *								
	City government tax revenue	City government expenditure	Local employment	Area income	Crop production	Gross value agriculture/ industrial output	Water quality indicators (e.g. N, P, BOD, COD)	Eco-system indicators (e.g. bio-diversity)	Other
1. Close down lakeside fertiliser plant									
2. Mandatory effluent treatment facility for battery factory									
3. Close 130 over the water restaurants									
4. Ban open water cage fish rearing									
5. Shorten open season for artisanal fishing									
6. Ban motorised tour boats									
7. Shoreline tree planting on 200m strip									
8. Stricter control on lakeside hotel construction									
9. Strengthening levees on both banks of Erjang river									
10. Issue permit for use of open water for commercial fish enterprises **									

* Quantitative or Qualitative; analysis should include projections for future years, where appropriate.

** For exotic species such as "yinyue" silverfish, crab (from Tai lake), and crayfish (from Australia) stocking and harvesting.

Table 7a. Analytical results of Tool 7 (Part 1) - Resource-Influence Analysis of Qionghai Lake and Related Subwatersheds, Primary Stakeholders

Primary Stakeholders & Resource use category	Any formal license, title or legislative provision (Yes/ No)	Stakeholder power or access score Strong (S), Moderate (M), Weak (W)			Comments
		Informal power/ influence	Financial power/ resources	Skills, knowledge/ information	
Xichang Urban residents: Domestic water	No	M	M	M	Though not formalised, city government is obliged to provide acceptable quality water for urban consumption; informal power rests in the number of commercial businesses & government officals resident in urban centre
Lakeside paddy farmers: Irrigation water (Hainan, Chuanxin, etc.)	No	W	M	M	Food production goals & irrigation revenue means farmers receive direct or indireet government support in maintaining irrigation water resource
Farmers in hills around lake: Farming on dryland, converted wasteland (Daxin)	Yes	M	M	W	Permits for land conversion granted by Territorial Bureau/ Forestry Bureau (requires confirmation); Tobacco development Office may provide support for expansion of tobacco cultivation
Upstream farmers of Guanba & Erjang subwatersheds: Farming on dryland, converted, pastures, wasteland	Yes	W	W	W	Farmers pay agricultural tax of 7 yuan/ mu for village allocated land, but tax revenue may not reflect full extent of land use for crops, especially in more remote areas; farmers have own production/ land protection strategies, but hampered by skills and resource availabilty (e.g. cash for cement, gully planting materials)
Licensed individuals: Open water fishing	Yes	M	M	M	Licenses at 640 yuan/year per boat (yuan 150 & yuan 120 per year for shrimp & line fishing); some poaching is apparent & reflect local peoples' continuation of informal open access traditions
Commercial & joint venture companies: Lake for fish stocking & harvesting	Yes	S	S	S	Commercial companies have 5 year licenses for open water useage; joint ventures involve Ethnic Minority Affairs Office participation, hence have political clout
Lakeside residents: lake as sink for wastewater	No	M	M	W	Rights of use from tradition; government plans for ring sewer for implementation only from year 2005.

Table 7b. Analytical Results of Tool 7 (Part 2) - Resource-Power-Influence Analysis of Qionghai Lake and Related Subwatersheds, Secondary Stakeholders

(Assessment: S = strong; M = medium; W = weak)

Secondary Stakeholder	Legislative/ administrative authority for resource management	Financial resources/ programme budgets *	Role in resource management functions:			Comments
			Enforcement	Planning	Coordination	
Qionghai Lake Management Bureau (QLMB)	S	M	S	M	S	Has own revenue base from license fees & supported by high level coordination committee at city & prefecture level; no control links over sectoral bureau programmes, who have their own funding.
Environmental Protection Bureau	S	W	S	W	M	Functions include monitoring of point & non point source pollution; some roles overlap that of QLMB; low revenue base from fines/ levies & sale of environmental monitoring data.
City Planning/ Finance Bureau	S	S	W	M	S	Has strategic control over specific sectoral development programme budgets, but own expenditures limited.
Agricultural Bureau	M	S	W	M	M	Food production targets & funding under 9th FYP can impact on farmer land use decisions.
Tobacco Development Office	M	S	W	W	W	Expansion of tobacco production under 9th FYP can impact on land use & fuelwood demand.
Xichang Tourism Office	M	W	W	W	M	Largely sector-specific interests, few staff & resources.
Forestry Bureau/ Farm	S	M	S	M	W	Roles for protection & commercial timber forestry; quandary under present forestry law linking tree harvesting to planting stipulations; little technical input into agro/ social forestry at farm household level.
Soil & Water Conservation Office	M	W	W	W	M	Formed out of Water Conservancy & Hydro-power Bureau very recently; few resources & programmes as yet.
Territorial Bureau	S	M	W	M	M	Has acted as integrative force in agricultural sector resources assessment & zonal planning; but along with Forestry Bureau, being affected by recent national bureaucratic reorganisation.

* Note that access to information and availabilty of technical, planning, and management skills also convey power and influence to the stakeholder. These aspects should be included in more detailed analyses of this kind.

Table 8. Analytical Results of Tool 8 - SWOT Analysis, Qionghai Lake Management Bureau

Criteria	Strengths	Weaknesses	Opportunities	Threats (Hazards or Constraints)
Role definition & scope of responsibilities	a) Control & enforcement functions for use of qionghai lake resources clearly defined; b) There are also provisions for coordination through high level prefecture & city level multi-sectoral committees.	a) Depends on cooperation of other government agencies, through coordination by high level prefecture & city committees; these meet only intermittently & may be too unwieldy for effective communication/ information exchange; b) Strategic planning function not apparent; c) Role in protecting aquatic eco-system integrity of lake, including bio-diversity, not sufficiently clear.	Scope for enhancing role in information exchange, & greater publicity on environmental goals and objectives; acting as repository of routine information on lake environmental quality & resource use/ sustainability indicators.	QLMB has taken over many functions of other government agencies; may not find ready future cooperation from sectoral bureaus, each with own development priorities (e.g. Forestry Bureau timber industries); despite workings of high level coordinating committees, conflicts of interest possible.
Legal authority	Authority clearly defined by 1997 Prefecture & City Legislations/ Regulations.	No provision by local government legislation for greater involvement of local people & private organisations in environmental protection (e.g. citizens complaint mechanism).	Making more provision for partieipation of general public in environmental problem identification, monitoring/ feedback & in devising solutions.	Local government regulations may sometimes clash with national/ provincial legislations e.g. forestry law; incentives for sound resouree management may be affected.
Area coverage	Fairly comprehensive physical system basis for management of water body, shoreline & relevant suhwatersheds of Guanba & Erjang	Whilst all Erjang subwatershed is covered by the 1997 legislation, the upper reaches of Guanba that fall within Zhaozue county lies outside jurisdiction of QLMB.	QLMB to liase via prefecture government with Zhaozue county & Hongxin township regarding future upstream environmental protection initiatives.	Zhaozue & Hongxin development priorities in upstream areas may conflict with QLMB environmental protection objectives.
Financial resources	Own revenue generation from licensing/ fees from fishing, tourism boats, fines, etc.	No funding for addressing upstream resource degradation root causes; weed clearance of water hyacinth cost 60,000 yuan in 1996, expected 100,000 yuan in 1998.	Future funding for comprehensive management of lake & the two relevant subwatersheds to be planned for, by first formulating long range natural resouree & environmental protection strategic plan.	Areas of concern may already fall within development programme areas of sector agencies, who may or may not accord priority to QLMB plans and activities.
Human resources	Numerical staff strength of 18 at present appear reasonable.	Additional technical skills on strategic planning for overall lake & subwatersheds system, and eco-system approach to resource management needed.	Enhancing technical & conceptual skills through training & study visits for QLMB personnel on wetlands & aquatie eco-system management & on watershed management.	Availability of suitable manpower for training unclear.

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This publication presents an overview of the concepts and definitions of environment and sustainable development, showing the importance of environment and natural resources for the economies of developing countries. It provides basic knowledge and analytical tools related to environment-economy interactions and how these should be taken into account in decision-making at a decentralized, or subnational, level. It reviews the role of government and the instruments at its disposal, in addition to regulatory instruments, to create a context in which environmental issues are analysed and addressed.

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